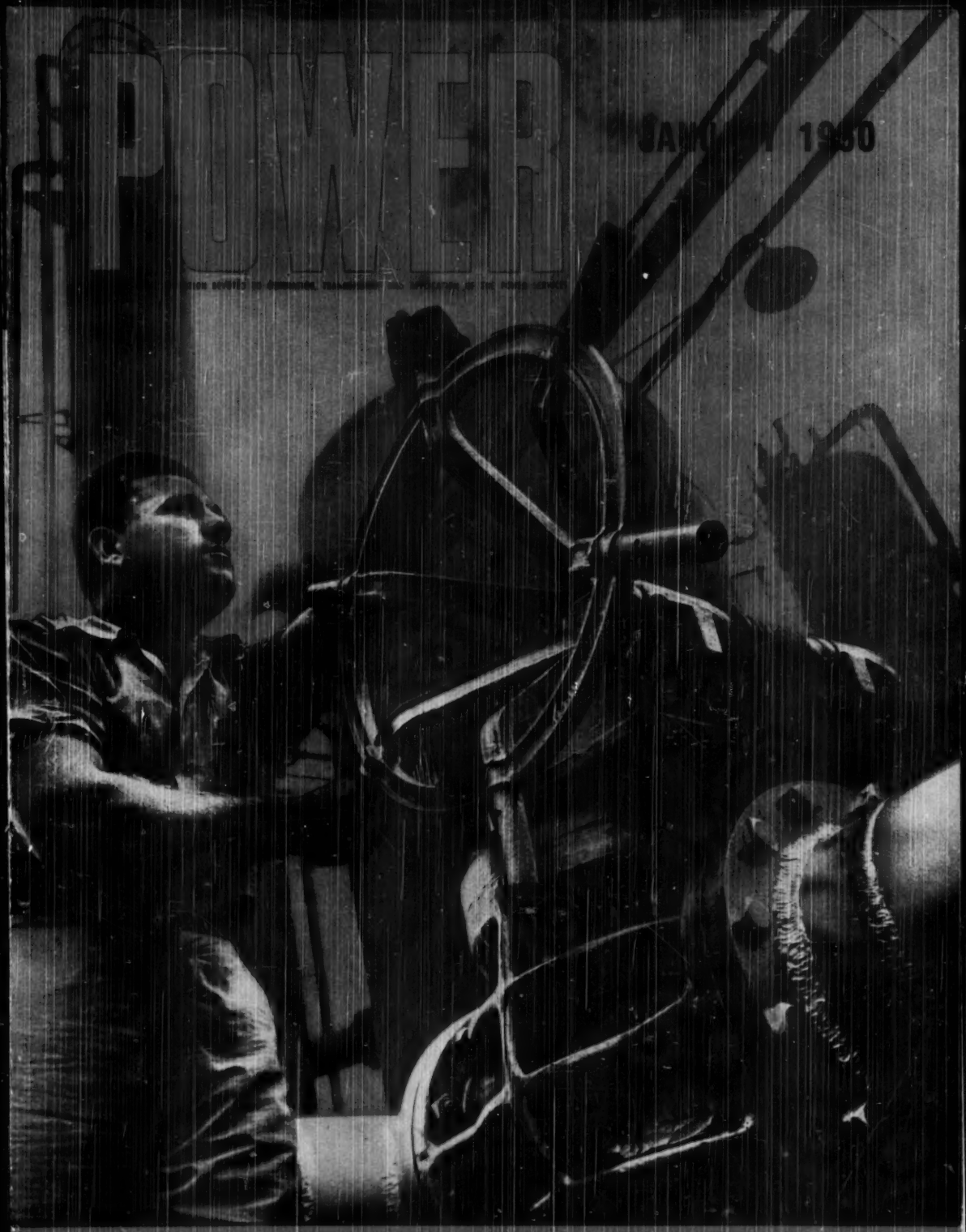
POWER

JANUARY 1950



IN THIS ISSUE: Accumulator with special controls evens out hosiery mill's steam peaks, cuts need for additional boiler capacity, p 96; experts take a look at the future, predict what's ahead for steam turbines, generators, and motors, p 102; new simpler test method checks water hardness faster and more accurately, p 105. CONTENTS, p 69

4 reasons why Micromax Control gives uniform superheat temperature

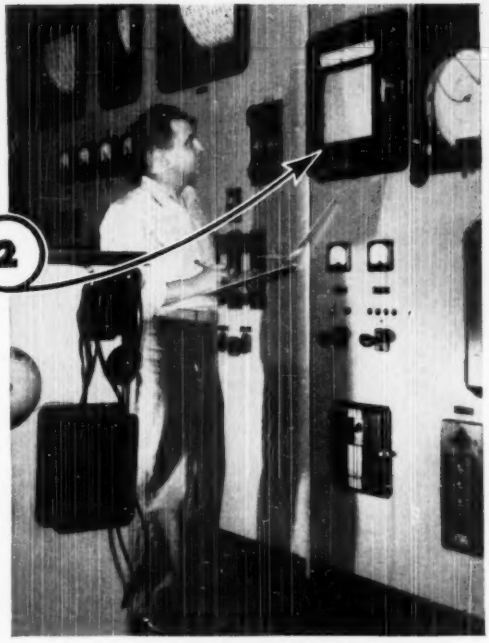
1

HIGH SPEED THERMOCOUPLE responds 3 times as fast as usual detectors for steam header installation. Metal-to-metal contact between couple and its protecting tube speeds transfer of heat from steam to the low-mass detecting element. The whole assembly is rugged, stable, withstands vibration, is easily mounted in high-pressure piping.

MICROMAX TEMPERATURE CONTROLLER embodies years of L&N know-how in temperature measurement and control. Accurate and sensitive, it operates through its control system to hold superheat at the specified top safe limit, no matter how boiler load varies.

ELECTRIC DRIVE UNITS, powerful and reliable, move all controlled elements. High starting torque moves heavy friction loads smoothly and continuously. Worm gear train makes backdriving impossible. Dampers, valves, burners can be moved readily by handwheels in event of power failure. There's no danger of freezing or clogging control lines.

2



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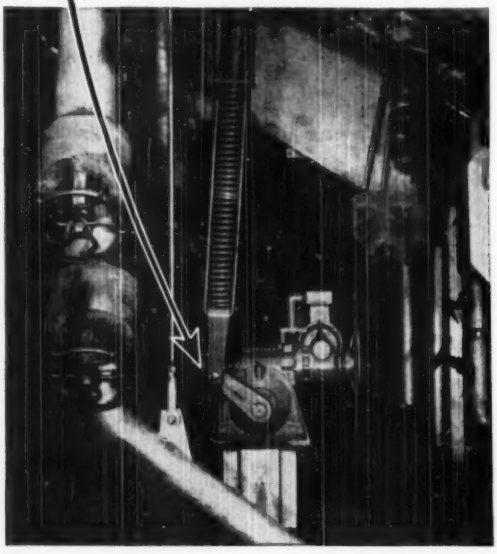
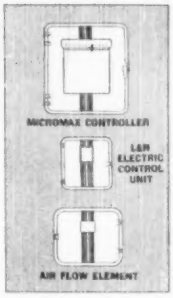


TWO ELEMENT CONTROL anticipates temperature changes even before they reach the thermocouple. Its Air Flow Element makes primary movement of dampers, etc., as soon as boiler load varies; while Micromax Controller follows with final adjustment based on actual steam temperature.

4



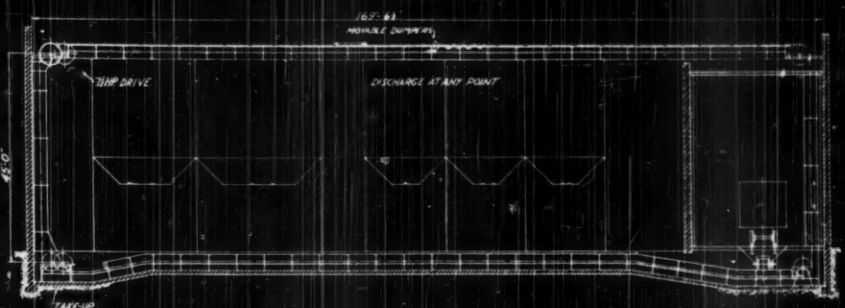
Combined in the Micromax system, all elements work together to give outstanding performance on any type of superheater equipment — bypass damper, spray desuperheater, attemperator, desuperheating condenser, burner elevation or any combination of these. For details, write to Leeds & Northrup Company, 4910 Stenton Ave., Philadelphia 44, Pa.

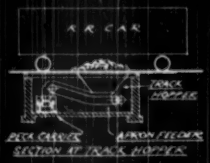
LEEDS & NORTHRUP

MEASURING INSTRUMENTS · AUTOMATIC CONTROLS · TELEMETERS
HEAT-TREATING FURNACES

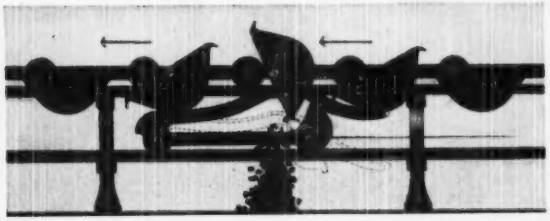
Jrl Ad ND44-33A-463(1)

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer"), January, 1950, Vol. 94, No. 1. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. Subscription rates—U. S. and U. S. Possessions $5 for one year, $7 for two years, 65c per copy. Canada $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.





Coal handling modernization pays off in textile plant



LINK-BELT Peck Carrier proves ideal solution

The above illustration shows the operation of the movable tripper of the Peck Carrier, to permit coal to be dumped at any point on the horizontal run.

The problem at the power plant of Dominion Textile Company, Limited, at Magog, Quebec, Canada, was to increase the steam generating capacity and to modernize the coal handling system to cut unloading time.

The boiler and track layout proved ideal for the use of a Peck overlapping pivoted bucket carrier, which would follow a rectangular path in a vertical plane (as shown by sketch), with the coal being delivered by railroad car through a track hopper to an apron feeder discharging to the carrier for distribution along the top horizontal run into storage bunkers. The coal can be discharged at any point along top run merely by presetting the dumper mechanism that tilts the buckets.

The operation of the Peck Carrier is quiet and there is no vibration since the buckets move slowly. The capacity of this plant was set at 45 tons per hour, but this figure has been exceeded.

This is but one of the types of modernization equipment designed, built and installed by Link-Belt for both small and large plant operation. Ask our nearest office for details.

TYPES OF LINK-BELT CONVEYING MACHINERY

Belt Conveyors	Bulk-Flo Conveyors
Bucket Carriers	Screw Conveyors
Bucket Elevators	Car Unloaders
Flight Conveyors	Coal Crushers
Chain Conveyors	Weigh Larries
Apron Conveyors	Skip Hoists

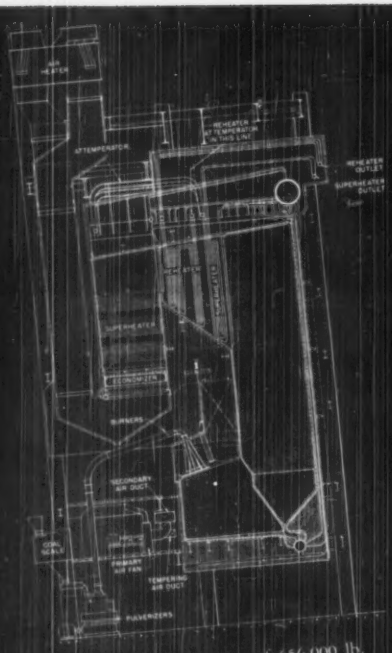
LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

11.052

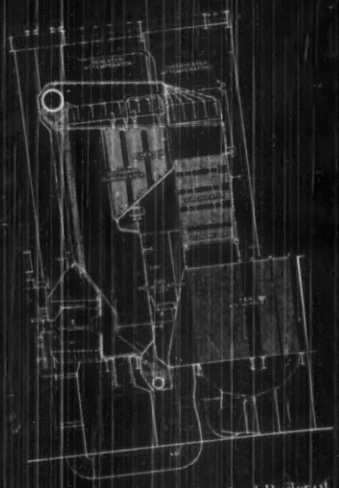
LINK-BELT

CONVEYING MACHINERY

"THE COMPLETE LINE"

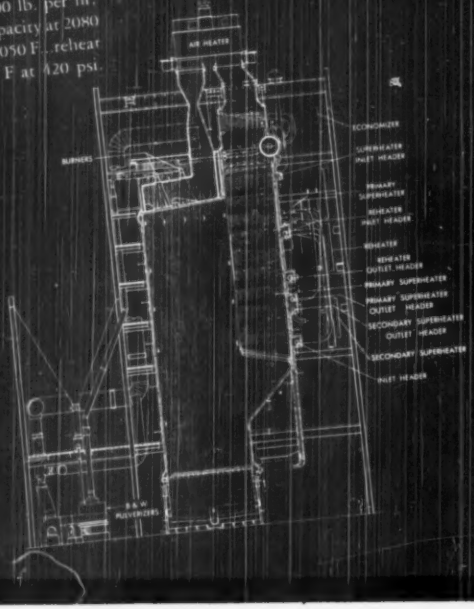


B&W Radiant Boiler of 656,000 lb. per hr. steam capacity at 1490 psi and 1000 F., reheat to 1000 F at 385 psi.

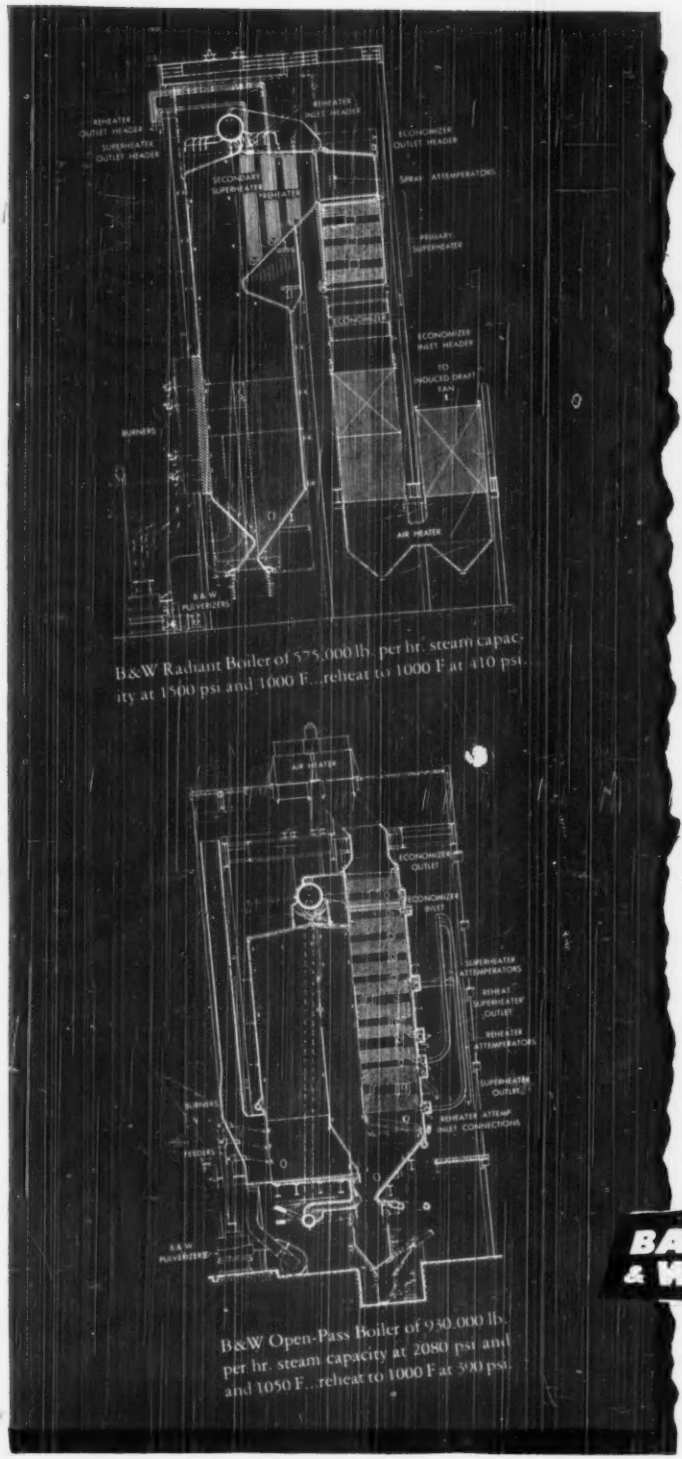


B&W Radiant, Cyclone-fired Boiler of 850,000 lb. per hr. steam capacity at 1850 psi and 1010 F., reheat to 1010 F at 530 psi.

B&W Radiant Boiler of 930,000 lb. per hr. steam capacity at 2080 psi and 1050 F., reheat to 1000 F at 420 psi.



B&W Radiant Boiler of 690,000 lb. per hr. steam capacity at 1480 psi and 1000 F., reheat to 1000 F at 585 psi.



Examples of B&W Engineering for economy

NEW REHEAT CAPACITY

with B&W STEAM

Today, with renewed interest in reheat strong among many power companies, B&W leadership in providing the most economical boiler designs incorporating reheat continues. For example, four identical B&W reheat units—the largest ever ordered—will comprise the largest new all-reheat station in this country. A fifth unit, of the same characteristics, is on order for another station in the same system.

Whether your current interest is in reheat or in the conventional superheat boiler, it will pay you, as it has so many other utilities, to consult B&W early in your plans for additional capacity or an entirely new plant.

B&W

BABCOCK & WILCOX

G-688

They build 'em

This photograph of an Elliott 975,000-lb-per-hr vertical deaerating heater mounted on a horizontal storage tank, was made on the assembly floor with the unit under final water test of 200 psi, and before the various gages and control valves were installed.

ELLIOTT DEAERATING

big at Elliott

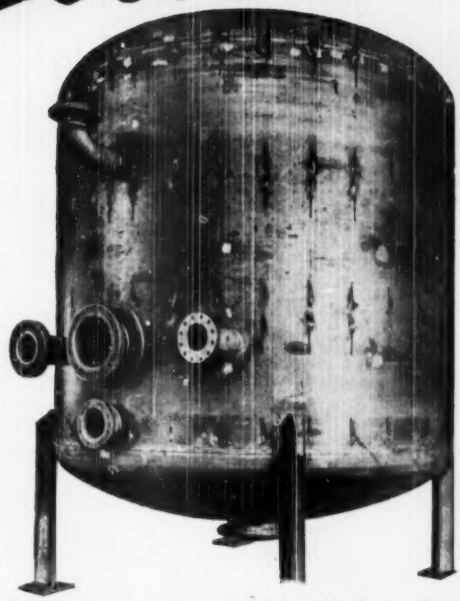
Utility companies have long been coming to Elliott Company for the biggest deaerating heaters required by their fine new stations. They know that Elliott engineers have unparalleled experience in building and applying deaerating heaters to get the most effective and efficient feedwater heating and deaerating results. *An example is the unit illustrated.*

The Elliott units going to plants both big and small now have the "new look." They no longer are encumbered with external vent condensers. Elliott has "built in" the vent condenser, making a more compact unit and one easier to maintain—two big advantages. In addition, in the new units, all interior parts exposed to possible corrosion are of stainless steel. Performance is as it always has been with Elliott units—par excellence.

Descriptive bulletin on request.

ELLIOTT COMPANY **Deaerator & Heater Dept.**
JEANNETTE, PA.

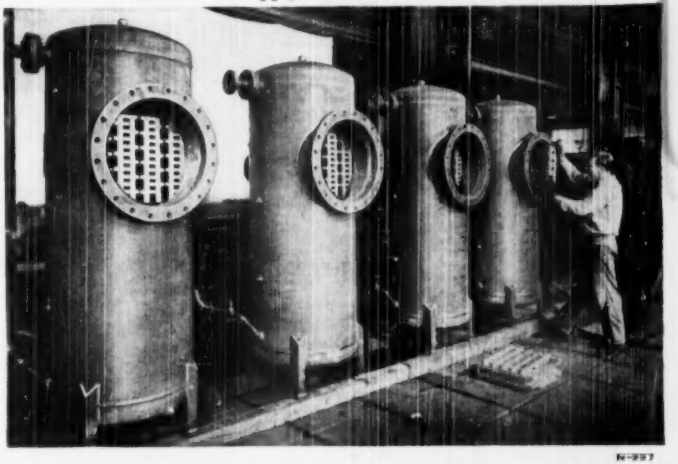
PLANTS AT: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES



This photograph shows the deaerating heater from the opposite side. At top is the relief valve opening; at bottom, the steam equalizing connection with the storage tank, and the three openings in a line are the main steam supply and the auxiliary drip returns.

... and small too

These four deaerating heaters of the new design, with built-in vent condensers, are being assembled ready for test. These units will serve as high pressure evaporator preheaters.



N-237

FEEDWATER HEATERS

have no tubular vent condensers

Television in Industry
. . . the DIAMOND "UTILISCOPE"

Checking Boiler Pilot Burner Flame Conditions with the DIAMOND "UTILISCOPE."

At Tidd Station of the Ohio Power Company, another highly successful use of the Diamond "Utiliscope" has been developed by engineers of the American Gas and Electric Service Corporation. As shown by adjacent photographs it is used to enable the control room operator to see for himself whether the burner pilots in a boiler furnace are burning. This is what the Ohio Power Company says in an article appearing in its employees paper: "Previously, the control room operator worked in conjunction with another auxiliary operator located at the boiler furnace burner area. Both communicating over a public address system. This occasionally led to confusion, delay and hazardous practices during the critical period of igniting oil burners to bring the boiler into service."

There are innumerable other uses for the "Utiliscope" because with it you can see where you can't look.

"Utiliscope" monitor or receiver is incorporated in control room panel where six glowing discs indicate that all pilot burners are lighted and that main burners can be turned on with safety.

"Utiliscope"—Registered U.S. Patent Office

"Utiliscope" camera is focused upon master mirror which receives reflections of six cateyes from smaller individual mirrors. In this way, flame conditions of six different ports in the furnace are watched by one camera.

DIAMOND POWER SPECIALTY CORP.

DETROIT 31, MICHIGAN

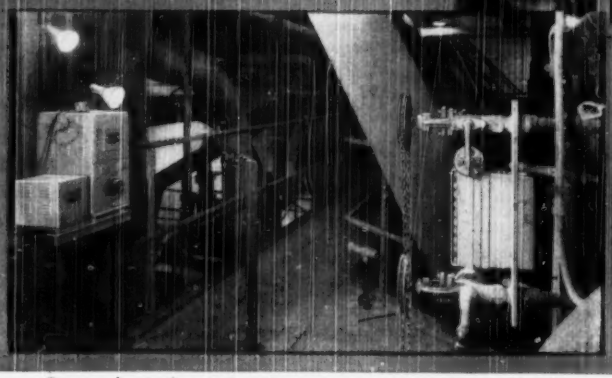
Diamond Specialty Limited — Windsor, Ontario

"Increased efficiency and safety in operation of boiler units has been the result."

(STATEMENT IN EMPLOYEE PUBLICATION OF OHIO POWER CO.)

Reading Boiler Drum Water Level with the DIAMOND "UTILISCOPE"

Tidd Station also uses a "Utiliscope" to bring the image of the boiler water gauge to the control room. With 60 individual images per second (sound motion pictures have only 48 per second), any change is instantly registered on the viewing screen . . . there is no measurable time lag. Distance, intervening walls, obstructions of any kind cause no difficulty. The "Utiliscope" has exceptional stability and reliability; it has fewer tubes than a good radio set and is built for continuous operation at temperatures up to 130° F. Installation requires no special skill and only a screw driver is needed for adjustment of focus, brilliance and contrast to suit individual preference.



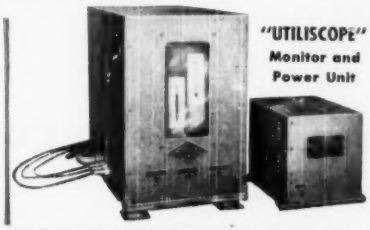
Exact image of boiler water level gauge is always before control operator on the "Utiliscope" screen. There can be no mistake . . . the correct water level is shown or there is no image.

The attention of the "Utiliscope" camera never wanders; it is permanently focused on boiler water gauge and continuously sees and shows every minute variation in water level.

Write for Bulletin No. 1013 which illustrates the "Utiliscope," describes its operation and suggests various applications that promote safety and economy.

For exactly, simultaneously and continuously picturing at a remote point . . . an object, operation or condition

"UTILISCOPE" Camera and Power Unit



"UTILISCOPE" Monitor and Power Unit

The "Utiliscope" is a product of the Capehart-Farnsworth Corporation and the Diamond Power Specialty Corp.

OTHER USES

- To observe coal feed to pulverizers or stokers.
- Destructive testing without endangering the operator.
- To observe secondary combustion, slag flow, etc.
- To check stacks for smoke.
- To reproduce readings of electric meters, liquid level or temperature gauges, etc., located at remote or inaccessible places.
- To observe radioactive materials behind barriers.

3933

In Modernization, FLEXIBILITY COUNTS

GET POWER WITH

In plants where modernization programs frequently require shifting of equipment from place to place, drives with flexibility of application are a "must". This is one more reason why General Electric's STANDARD line of mechanical-drive turbines is winning such favor with progressive industries. The DP turbine can be easily transferred from one job to another, its speed and range changed easily, its horsepower rating adjusted economically.

DP TURBINES PROVIDE FLEXIBILITY THREE WAYS

1. EASY TO RE-LOCATE

Shaft height is the same on all G-E standard single-stage turbines. This means that moving turbines from one job to another doesn't require a "custom line-up job." Not only shaft height, but size of coupling fit and keyways are standard on every unit.

DP turbines are quickly aligned, too. Unless casing temperatures are high, DP's can be lined up cold with the assurance that shaft lift will be within allowable limits when the turbines are heated. Such easy alignment is possible only on a center-line supported unit.

2. EASY TO ADJUST SPEED

By adjusting a simple handwheel, the speed setting can be varied within a 30% range. Once adjusted, the DP's hydraulic governor holds speed accurately.

If a change in application makes a new speed range necessary, the range can be set anywhere from 800 to 5000 rpm by simply substituting a new emergency governor and a new set of low-cost gears on the governor drive. These gears are standard, available on immediate delivery from the factory.

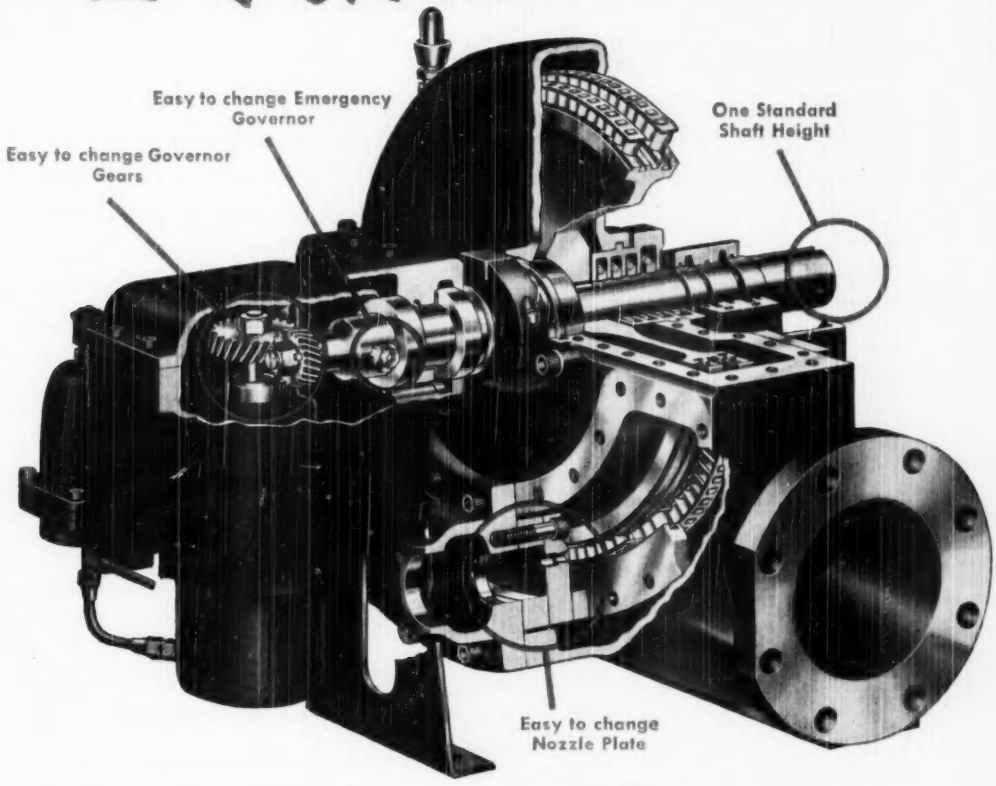
3. EASY TO CHANGE RATING

When steam conditions or load demands change, a DP turbine can be adapted at a reasonable cost for the new requirements if they are within the steam flow capacity of the casing. Example: If it is desired to increase the horsepower rating, the only changes which are usually necessary are new nozzle plate and valve parts. The cost of such parts is far less than the cost of a new turbine—which would be required with a less flexible unit.

REMEMBER...

"DP means Dependable Power"

FLEXIBILITY G-E TURBINES



The General Electric standard DP Turbine incorporates many outstanding features previously found only on "special" turbines. They give you a drive which is dependable and flexible—ideal for a variety of applications in your plant.

For the full story on how these features can mean operating benefits for you, call your G-E representative. Or write today for GEA-4955, a 20-page, descriptive bulletin. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

252-13

Here are the benefits you get from

BAILEY CONTROLS

1. Fuel Conservation without decrease in output.

2. Lower Cost Steam.

3. Increased Safety for Plant and Personnel.

4. Better Power Service.

Bailey Controls for boilers make the important factors of steam plant operation work together to insure ideal performance.

In order that all of these factors may be regulated in harmony with each other and the load demand, Bailey Controls are carefully engineered to the requirements of the units which they serve.

Bailey engineering service starts with the selection of suitable metering and control equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Bailey field engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey engineer in your community has extensive experience at his command, which includes tests on thousands of boiler installations, covering a wide range of fuels, furnaces and fuel burning equipment. He is in a position to help you secure the many benefits resulting from intelligent use of correctly selected and properly applied boiler control.

Bailey Controls for boiler operation are described in Bulletin 15-C. Write for your copy to Bailey Meter Company, 1036 Ivanhoe Road, Cleveland 10, Ohio —in Canada to Bailey Meter Company Limited, Montreal.

FUEL CONVERSION

If it becomes desirable or necessary to convert to another fuel, Bailey Controls can be adjusted easily to insure optimum results from the new fuel.

G-26

BAILEY METER COMPANY

1036 IVANHOE ROAD • • • CLEVELAND 10, OHIO

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Controls for Steam Plants

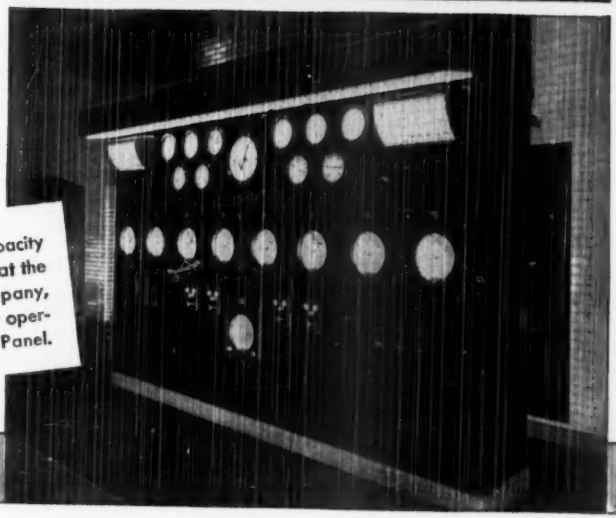
APPLICATION to STOKER FIRED BOILERS

UNDERFEED

This Bailey Control Panel insures optimum performance from three underfeed stokers on two 25,000 and one 40,000 lb. per hour capacity boilers at Parker Appliance Company, Cleveland, Ohio.

SPREADER

Bailey Controls help operators at Graham-Paige Motors Corporation, Detroit, Michigan, to maintain tests standards in everyday operation of this 60,000 lb. per hour boiler fired by a spreader type stoker.



CHAIN GRATE

Two 40,000 lb. per hour capacity chain grate stoker fired boilers at the United States Tobacco Company, Chicago, Illinois, are efficiently operated by this Bailey Control Panel.

KVS

AIR SWEPT TUBE MILLS . . . .

provide a continuous reserve of superfine fuel . . . regardless of coal quality

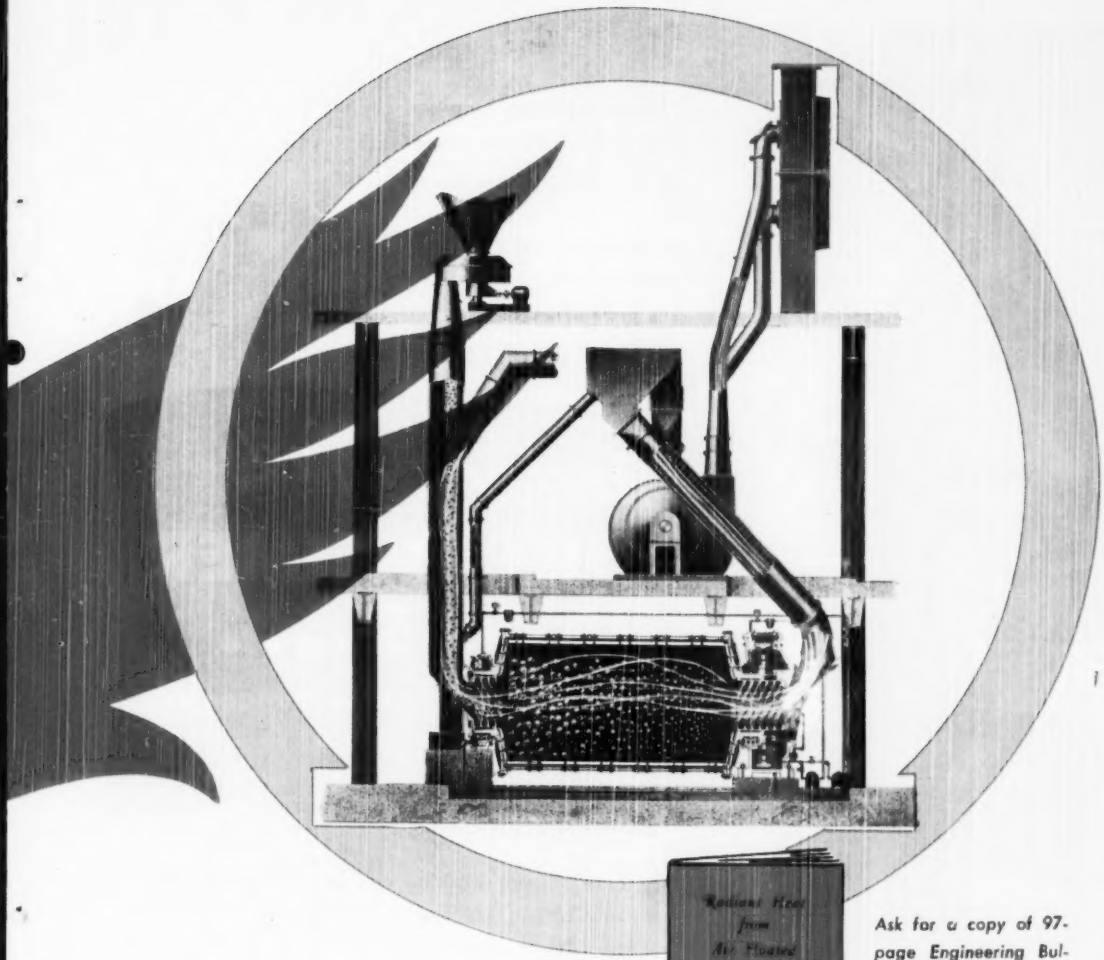
Coal, ground in preheated air, is floated out as superfine, carbureted fuel. Oxygen and carbon combine to provide, in effect, a highly combustible gas.

Coal containing from 5% to 15% moisture is direct-fired without the use of a separate dryer. No magnetic separator is used. Tramp iron actually helps grind coal.

Fine pulverization of any quality of coal results from the hammer-and-anvil effect of thousands of blows per minute by XX Herculite steel balls on coal particles against XX Herculite mill liners, with a minimum of ball wear.

99% availability . . . and better . . . contributes materially to low operating cost.

All components of KVS Steam Generating Units are engineered to meet specific operating conditions on available fuels for high operating efficiency and a maximum of economy at all boiler ratings.



Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

KVS ENGINEERING SERVICE

KVS offers a complete service in design, building and erecting complete steam generating plants under one responsibility. KVS engineers are available for consultation on your requirements.

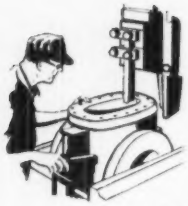
Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA

CANADA • ENGLAND • FRANCE • AUSTRALIA



A DISTINCTIVE FEATURE IN DISC GUIDING

Body guides are machined down to precision tolerances, assuring a perfect guide for the disc and creating a positive center line on which all subsequent machining operations are based.

BODY PRECISION MACHINED TO INSURE PERFECT FIT OF SEAT RINGS

This operation makes inserting the seat rings in a Lunkenheimer gate valve simply a matter of screwing them into position. Parts can be replaced without any machine work or special fitting.

Precision Made LUNKENHEIMER VALVES....

assure perfect-fitting, interchangeable parts . . . longer valve life . . . easier, lower-cost maintenance!

THE smooth working efficiency and low maintenance cost of Lunkenheimer Valves were not "made in a day." Behind this superior performance and economy lies long experience, top engineering and metallurgical facilities together with the most modern manufacturing equipment.

Lunkenheimer Valves have a streamlined simplicity of design . . . a minimum of working parts, each part of extra strength, correctly proportioned and perfectly balanced. This assures longer life with lower maintenance expense.

Fig. 1430 LUNKENHEIMER IRON BODY GATE VALVE

Fig. 1430 and complete line of I.B.B.M. and All Iron Gate Valves are described in Circular 564. Available from Lunkenheimer Distributors or direct.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

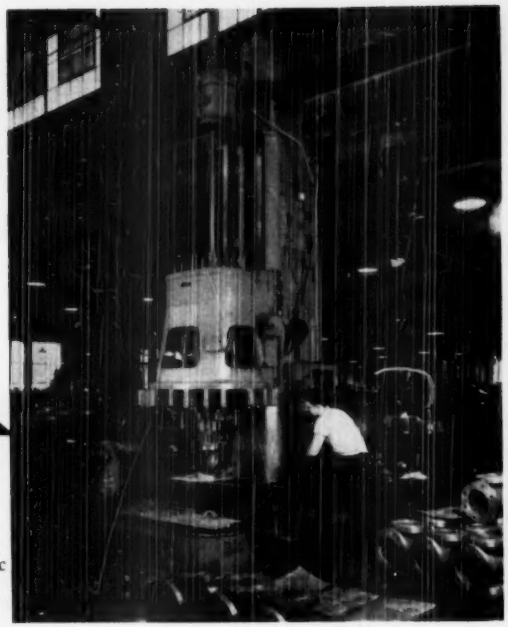
CINCINNATI 14, OHIO, U.S.A.

NEW YORK 13 • CHICAGO 6 • BOSTON 10 • PHILADELPHIA 34

EXPORT DEPT. CINCINNATI 14, OHIO, U.S.A.

Simplicity of design . . .

Modern Facilities like this . . .



Through its continuous modernization program, Lunkenheimer provides the latest in manufacturing, engineering and research. New equipment of all kinds, the latest in machine tools, like the multiple spindle drill with hydraulic feed shown at right, assure ever higher accuracy, continually better products.

Fig. 1123 LUNKENHEIMER I.B.B.M. GLOBE VALVE

Globe and Angle Valves available in I.B.B.M. and All-Iron patterns — screw or flange ends.

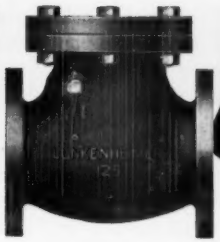


Fig. 1790 LUNKENHEIMER I.B.B.M. SWING CHECK VALVE

Swing Check Valves are available in I.B.B.M. and All-Iron patterns — screw or flange ends.

DEPEND ON YOUR LUNKENHEIMER DISTRIBUTOR FOR SERVICE AND REDUCED VALVE INVENTORY!

Many concerns, large and small, have found real savings by depending on the complete stocks of Lunkenheimer Distributors. Capital formerly tied up in slow-moving inventory is available for other uses; losses from obsolescence are eliminated or drastically reduced. Ask your Distributor how he can help you.

reduces maintenance costs!

C-E Vertical-Boilers

Modern steam generating equipment can't lower the price of a ton of coal or a barrel of oil, but it *can* produce *more* steam from every ton of coal or every barrel of oil. The modern unit can't lower the cost of a man-hour, but it *can* and *does* operate so reliably that maintenance costs are kept at a minimum.

C-E Vertical-Unit Boilers represent truly modern standards of design. To an exceptional degree they incorporate all the important advances in steam generation made in the past twenty-five years . . . advances that have resulted in substantially increased efficiencies and lower operating costs. At today's high costs of fuel and labor, these gains in operating efficiency may well prove the difference that will make replacement a profitable procedure for you. So whether you are considering the purchase of equipment for replacement or expansion, or for a new plant, a C-E Vertical-Unit Boiler will provide the right answer to your particular situation.

The three units illustrated—and others in the Vertical-Unit line not shown—are collectively designed to serve virtually every industrial requirement from about 10,000 to 300,000 (or more) lb of steam per hour, pressure up to 1,000 psi and steam temperatures to 900 F. The entire Vertical-Unit line offers the advantages of time-tested standards of design coupled with that flexibility of application—fuels, firing methods, operating conditions, etc.—required to meet particular plant needs. We shall be pleased to supply catalogs and any additional information required upon request.

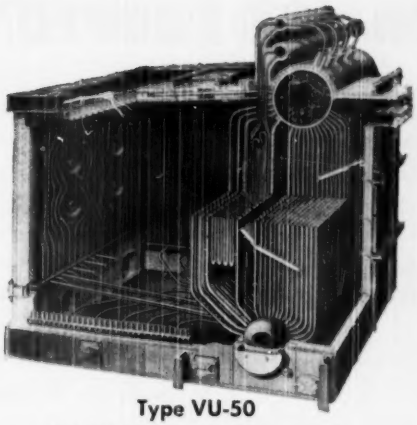
B-371

COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

-Unit

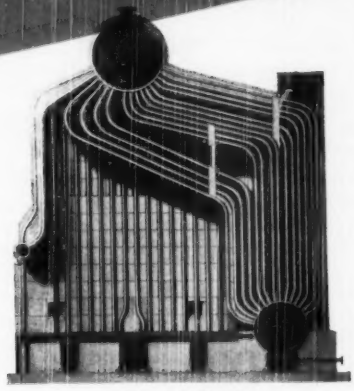
today's best answer to high steam costs



Type VU-50

(for the higher capacity range)

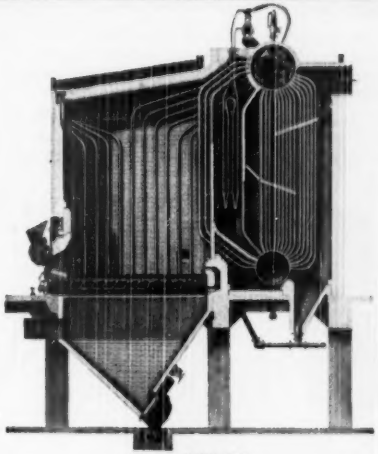
This unit, the original VU design, may be fired by pulverized coal, oil or gas, or any combination of these fuels. Available for capacities up to 300,000, or more, lb of steam per hr, pressures up to 1000 psi and steam temperatures up to 900 F, or higher. Furnace bottom may be as shown or may be of hopper type. Economizer or air heater surface may be added.



Type VU-10

(for the lower capacity range)

This member of the VU family is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 10,000 to 50,000 lb per hr. Firing may be by spreader, underfeed or chain grate stokers, or by oil or gas burners. Any of these methods may be substituted for any other, should fuel market conditions make this desirable.



Type VU-30

(for the middle capacity range)

In this VU design, shown equipped with a C-E Spreader Stoker, the furnace proportions and arrangement of water wall surfaces may be adapted for firing by any type of mechanical stoker. Design is also adaptable for firing by oil or gas. Economizer or air heater surface may be added. Approximate capacity range 25,000 to 100,000, or more, lb per hr.

—SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

SUN "JOB PROVED" PRODUCTS CUT COSTS,

Sun products have been "Job Proved" in the lubrication of almost every type of mining, manufacturing, power, and transportation equipment . . . in refrigeration and air-conditioning . . . in metal cutting, tempering, and quenching . . . in the processing of textile fibers, leather, natural and synthetic rubbers . . . in the impregnation of electrical, electronic, and packaging materials of many kinds.

To help you solve your production problems, Sun Oil Company offers a wide selection of "Job Proved" petroleum products, plus the experience of Sun Engineers. Their know-how and detailed product information are yours for the asking. Call your local Sun office, or write Dept. P1.

SUN OIL COMPANY • PHILADELPHIA 3, PA.

In Canada: Sun Oil Company, Ltd., Toronto and Montreal

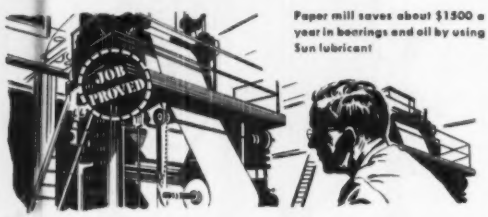
INDUSTRIAL OILS

SUNVIS 900 OILS—High-viscosity-index, paraffinic-type oils—of uniform O F pour point—fortified against rust, corrosion, oxidation, and sludge. The finest available lubricant for turbines, hydraulic systems, and similar applications.

SUNVIS HD 700 OILS—High-viscosity-index oils containing additives which minimize oxidation and give detergency. Ideal lubricants for internal combustion engines subjected to continuous heavy loads under the most adverse conditions.

SUNVIS OILS—Solvent-refined paraffinic-type oils of uniform high viscosity index, low pour point, and low carbon content. Especially suitable for application to long-time use in all types of industrial reservoirs and circulating systems.

DYNAVIS OILS—Low-pour-point, high-viscosity-index, inhibited oils, containing an additive which helps prevent formation of harmful corrosive and sludge-forming acids. Well suited for engines fitted with alloy bearings and operated at high temperatures.



Paper mill saves about $1500 a year in bearings and oil by using Sun lubricant

SOLNUS OILS—Well-refined straight mineral oils. Stand up under hard use for long periods of time. Recommended for use in machine tools, air compressors, certain types of diesels, etc.

CIRCO OILS—Used for general lubrication of industrial machinery when straight mineral oils are required.

SUNTAC OILS—100%-petroleum products which have been compounded to increase their adhesiveness. Recommended for general lubrication of all machines subjected to sudden shocks and load reversals. Cling to the parts to be lubricated.

STEAM CYLINDER OILS—High flash and fire point lubricants for either saturated or superheated steam conditions and for worm-gear speed-reduction units.

SUN CAR JOURNAL OILS—Dark oils meeting A.A.R. Specifications. For use in waste-packed bearings of railroad equipment.

SUN DELAWARE OILS—Dark oils for general lubrication on older types of industrial machinery.

SUNOCO WAY LUBRICANT—For use on tableways. Eliminates chatter and scoring . . . resists corrosion. Has good metal-wetting and adhesive properties, ample viscosity, and E. P. qualities.

SUN MARINE ENGINE OILS—Compounded with special emulsifying agents in order to provide adhesion to, and lubrication of, working parts in the presence of water. For the lubrication of bearings, eccentrics, crossheads, and various other parts of steam engines.

ROCK DRILL OIL—High-film-strength adhesive oil. For use in jackhammers, stopers, drifters, and similar equipment.

INDUSTRIAL GREASES

SUN CUP GREASES—Water resistant. For grease-cup and grease-gun application when service is normal.

SUN GUN GREASES—Smooth greases made with medium-viscosity oil. Stable under pressure in power and booster guns.

ADHESIVE PRESSURE GREASES—Won't drip or splash. Excellent lubricants for open-gear applications.

SUN DARK PRESSURE-SYSTEM GREASES—For power-driven central grease lubricating systems in heavy industries. Also used as a "medium cup grease."

SUN MINE CAR GREASES—Available in several grades. Suitable for both antifriction bearings and plain-bearing cavity-type wheels.

SUN MINING MACHINE LUBRICANT—Semifluid. For use where a light but adhesive grease is required. Resists separation and decomposition.

Chemical plant saves about $8000 per year by adopting Sun Pressure Grease

SUN ROLLER BEARING GREASES—For use on electric motors and generators and high-temperature machinery equipped with ball or roller bearings.

SUN GEAR COMPOUNDS—Black adhesive open-gear compounds and

"JOB PROVED" IN EVERY INDUSTRY

SUN PETROLEUM

SPEED PRODUCTION, IMPROVE QUALITY

wire-cable greases. Recommended for power presses, mining machinery, worn reduction mills, crushers, pump gears, etc.

SUNOCO TRACTOR ROLLER COMPOUND—For crawler-type tractors. Provides good lubrication with exceptional sealing qualities.

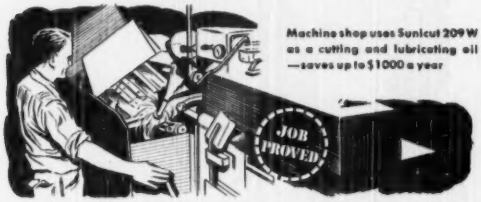
METALWORKING OILS

SUNICUT—Straight (non-emulsifiable) transparent cutting oils. Recommended for automatic screw machines and heavy-duty machining operations. Permit high speed production with excellent finishes, long tool life.

SUNOCO EMULSIFYING CUTTING OIL—A self-emulsifying oil which produces a stable white emulsion. Efficient and economical cooling and lubricating medium for turning, milling, drilling, and other metalworking operations on both ferrous and nonferrous metals. It is also an excellent grinding coolant.

SUN QUENCHING OILS—Specially refined oils designed to aid development of maximum physical properties in a wide variety of steels.

SUN TEMPERING OILS—Specially refined oils for tempering steel. Because of their low carbon content and stability under heat, these oils have an unusually long service life.



Machine shop uses Sunicut 209 W as a cutting and lubricating oil —saves up to $1000 a year

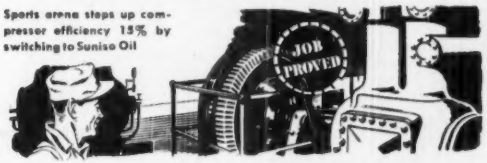
SUN ROLLING OILS—Straight and emulsifying oils which will permit maximum production in rolling steel, aluminum, brass, and copper.

SUN ANTI-RUST COMPOUNDS—Petroleum-base oils with chemical additives designed to prevent the rusting and corrosion of steel.

REFRIGERATION OILS

SUNISO REFRIGERATION OILS—Have extremely low pour points, extremely low wax-separating characteristics, a high degree of stability and long life. Initially neutral and resistant to formation of detrimental acids under service conditions. Suniso Oils are high quality oils suitable for both high- and low-temperature operations. The most widely used oils in refrigeration and air-conditioning.

Sports arena steps up compresser efficiency 15% by switching to Suniso Oil



TEXTILE-PROCESSING OILS

SUNOTEX TEXTILE OILS—Designed to impart certain additional properties to various forms of fibers during their processing from the fiber state into a manufactured product. All Sunotex textile oils are emulsifiable in water. Highest rating in fadometer tests.

SUN COTTON CONDITIONING OILS—Pale mineral oils which condition the cotton. They prevent waste by cutting down excessive amounts of "fly" (fine air-borne lint particles).

Worsted mill obtains easier scouring, better quality, larger yield with Sunotex WO-220

SUN ASBESTOS FIBER CONDITIONING OIL—Used for spraying on the asbestos during processing. Fibers are kept from being damaged or broken down, and harmful dust is minimized when this product is used.

SUN CORDAGE OILS—Generally used alone, but are adaptable to various formulas used by cordage manufacturers. Selected products, highly compatible with additives.

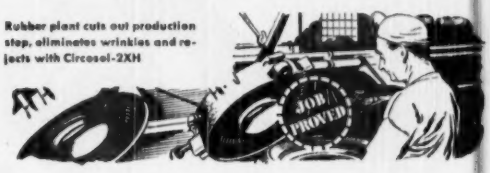
RUBBER-PROCESSING AIDS

CIRCOSOL-2XH—An elasticator and processing aid for natural rubber and especially for GR-S. Outstanding for sponge rubber.

CIRCO LIGHT PROCESS AID—A processing agent and excellent softener for natural rubber, natural rubber reclaims, and neoprene synthetic rubber. Used for GR-S to some extent.

SUNDEX-53—An inexpensive product suitable for processing GR-S and blends of GR-S and natural rubber. An established processing aid for rubber footwear stocks and semihard rubbers.

Rubber plant cuts out production step, eliminates wrinkles and rejects with Circosol-2XH



CIRCOMAR-5AA—A black-colored product for processing natural and GR-S rubber used in tire-making. Also used in reclaiming natural-rubber scrap. Replaces asphalt fluxes. Free-flowing at room temperature.

WAXES

Sun's new wax plant will be completed in 1949. Its many refining innovations and extreme flexibility will permit new types of waxes to be manufactured in large quantities—a procedure heretofore impracticable. A wide range of fully refined paraffin and microcrystalline waxes will be "tailor-made" to meet the requirements of virtually all major industrial applications. Pilot plant samples of several grades are now available.

MISCELLANEOUS INDUSTRIAL PRODUCTS

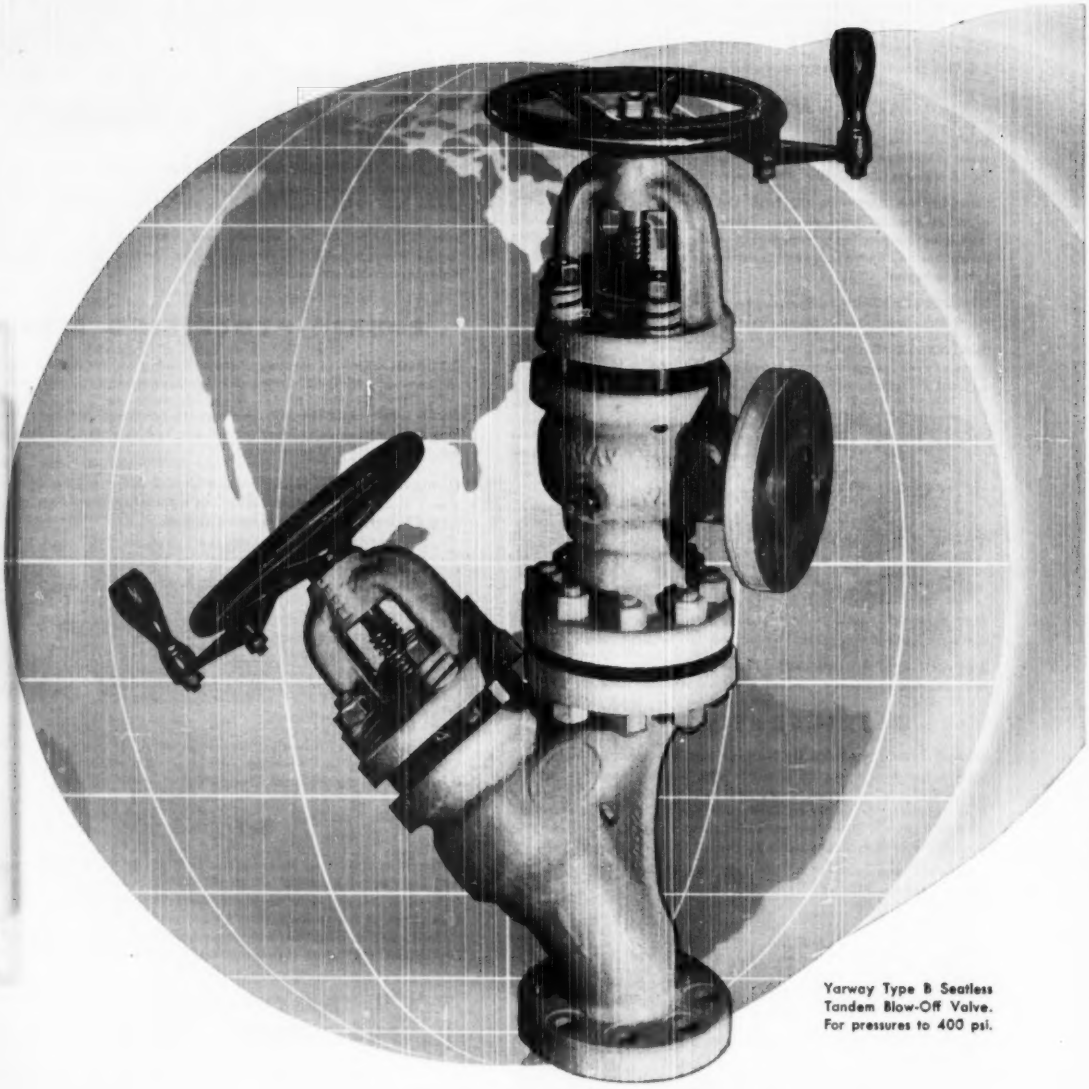
SUN SOLVENTS—Sun Spirits for the thinning of paints, varnishes, and enamels, and for metal-cleaning . . . a pure, water-white petroleum solvent free of corrosive sulphur. Other Sun solvents with special properties are available for the chemical industry.

SUN LEATHER OILS—Mineral-base leather oils. Used for obtaining the desired tensile strength, proper temper, and controlled moisture content. Maintain a light even color . . . mix well . . . distribute evenly.

"JOB PROVED" IN EVERY INDUSTRY

PRODUCTS

SUNOCO



Yarway Type B Seatless
Tandem Blow-Off Valve.
For pressures to 400 psi.

YARWAY

THEY KEEP BLOW-DOWN LINES TIGHT IN OVER 15,000 PLANTS

Yarway Blow-Off Valves are known in almost every plant where boilers are used to generate steam.

Why this thorough acceptance? Partly because the Yarway *Seatless* feature eliminates the commonest source of blow-off valve trouble. In Yarway *Seatless* Valves there are no seats to score, wear, clog and leak.

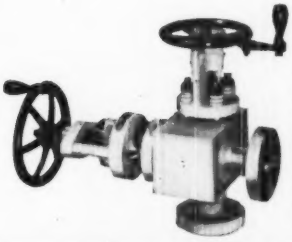
Partly because of Yarway's advanced designs—such as the Unit Tandem for high pressure work. This valve combines a Yarway *Stellite-Seat* Valve (for blowing) with a Yarway *Seatless* Valve (for sealing) in a solid, one piece forged-steel body.

And finally the dependable, trouble-free service of Yarway Blow-Off Valves prompts power plant engineers to insist on Yarways.

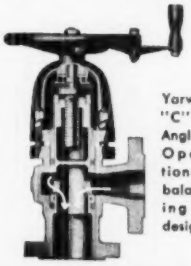
Regardless of the reason, the fact remains that today Yarway Valves are on the job—doing a good job—in more than 15,000 plants. How about yours?

Write for Bulletin B-424 for pressures to 400 psi. For higher pressures ask for B-432.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Penna.

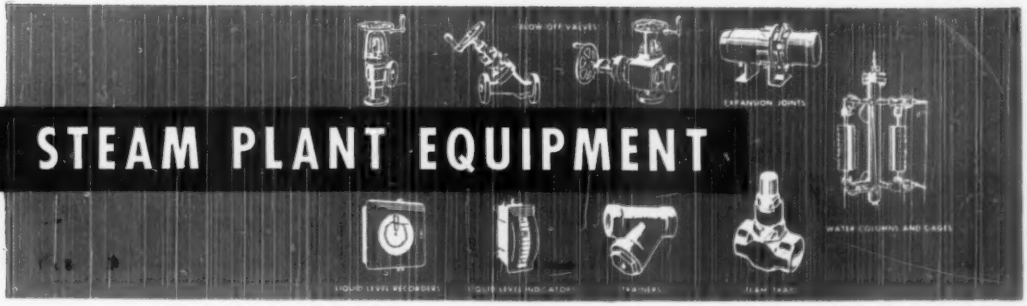


Yarway Unit Tandem Blow-Off Valve. Flanged type. Also available with welding ends. For pressures up to 2500 psi.

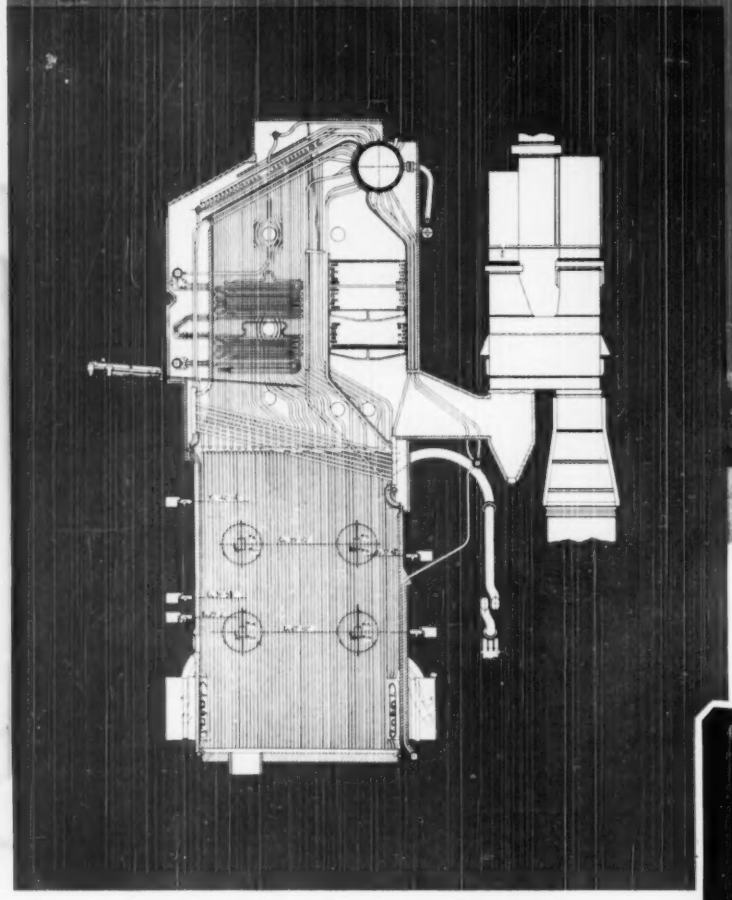


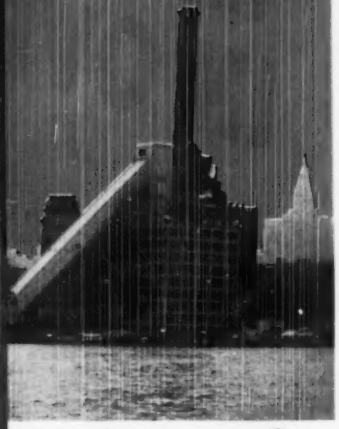
Yarway Type "C" Seatless Angle Valve. Open position. Notice balanced sliding plunger design.

Yarway Stellite-Seat Straightway Valve. Open Position.



. . . VULCAN Solves





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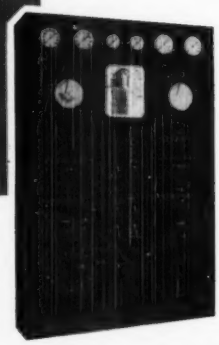
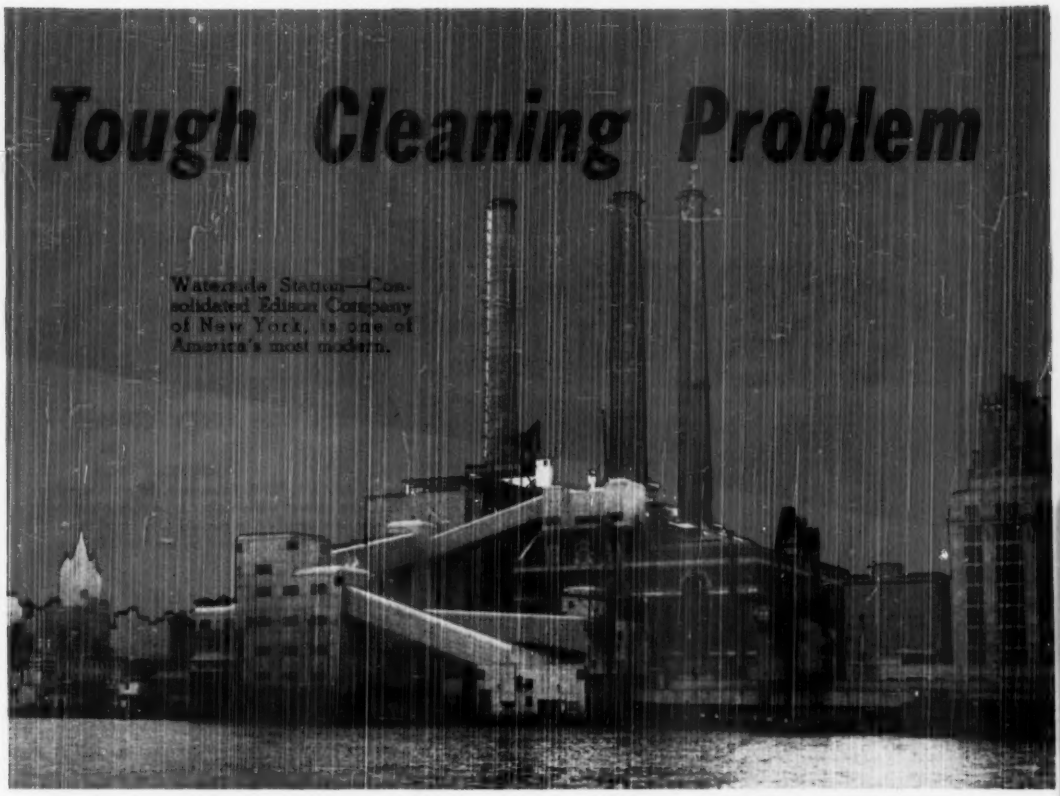


Side elevation, one of four 500,000-pounds-per-hour boilers at Waterside Station No. 2.

Central Vulcan Control Panel for Boilers 41 and 42 at Waterside Station No. 2. Panel for Boilers 51 and 52 is identical.

VULCAN *Automatic*



WORLD'S LARGEST PUBLIC UTILITY

Space limitations at Waterside Station No. 2 of Consolidated Edison Company of New York, world's largest public utility, were effectively overcome by Vulcan Automatic Sequential Soot Blowers. Each of the four 500,000-pounds-per-hour boilers has twenty RW-1 Deslaggers, plus five T-2 Long Retractables paralleling boiler tubes.

A tough problem, yes—but all boilers are kept clean without hand lancing, thanks to Vulcan engineering.

•

Vulcan also serves Consolidated Edison at Waterside No. 1, Hunt's Point and East River—and has been selected for Hudson Avenue's new 1,300,000-pounds-per-hour unit.

VULCAN SOOT BLOWER CORPORATION

DUBOIS, PENNSYLVANIA

Division of CONTINENTAL FOUNDRY & MACHINE COMPANY

On the evening of July 4th, 1883, Thomas A. Edison placed in operation the first three-wire central station electric lighting plant in the world at Sunbury, Pa. Power was supplied to the old City Hotel three blocks away which was then on the site now occupied by the Hotel Edison.

The world's largest power plant using pulverized anthracite has been completed recently on a site near Shamokin Dam along the Susquehanna River about two miles below Sunbury, Pa. This 150,000 kw installation, first of a number planned for the site, is part of the Pennsylvania Power & Light Company's network serving 28 counties which cover an area of 9,500 sq miles in central eastern Pennsylvania.

The two 75,000 kw turbine generators are served by four 130-ft high Foster Wheeler Steam Generators, the largest ever built for direct firing of pulverized anthracite.

An extension of 100,000 kw capacity, now under construction, will be completed in 1951 and equipped with Foster Wheeler Steam Generators.

FOSTER WHEELER CORPORATION • 165 BROADWAY

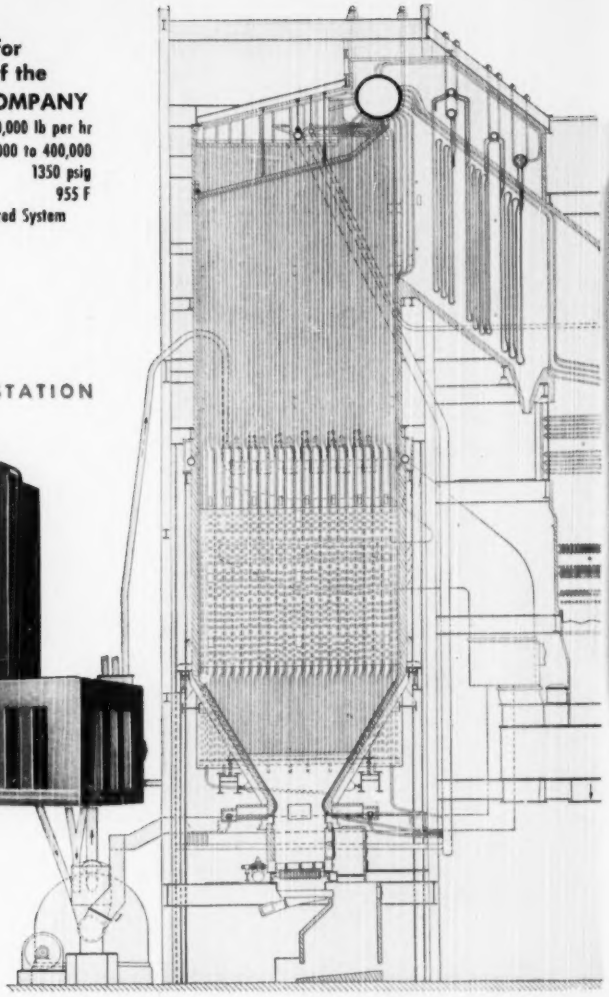
still lights the way

Four FOSTER WHEELER Units for Sunbury Steam Electric Station of the PENNSYLVANIA POWER & LIGHT COMPANY

Capacity	400,000 lb per hr
Superheat Control Range	250,000 to 400,000
Pressure Superheater Outlet	1350 psig
Final steam Temperature	955 F

Anthracite Coal Pulverized in FW Ball Mills in Direct Fired System

NEW SUNBURY STEAM ELECTRIC STATION

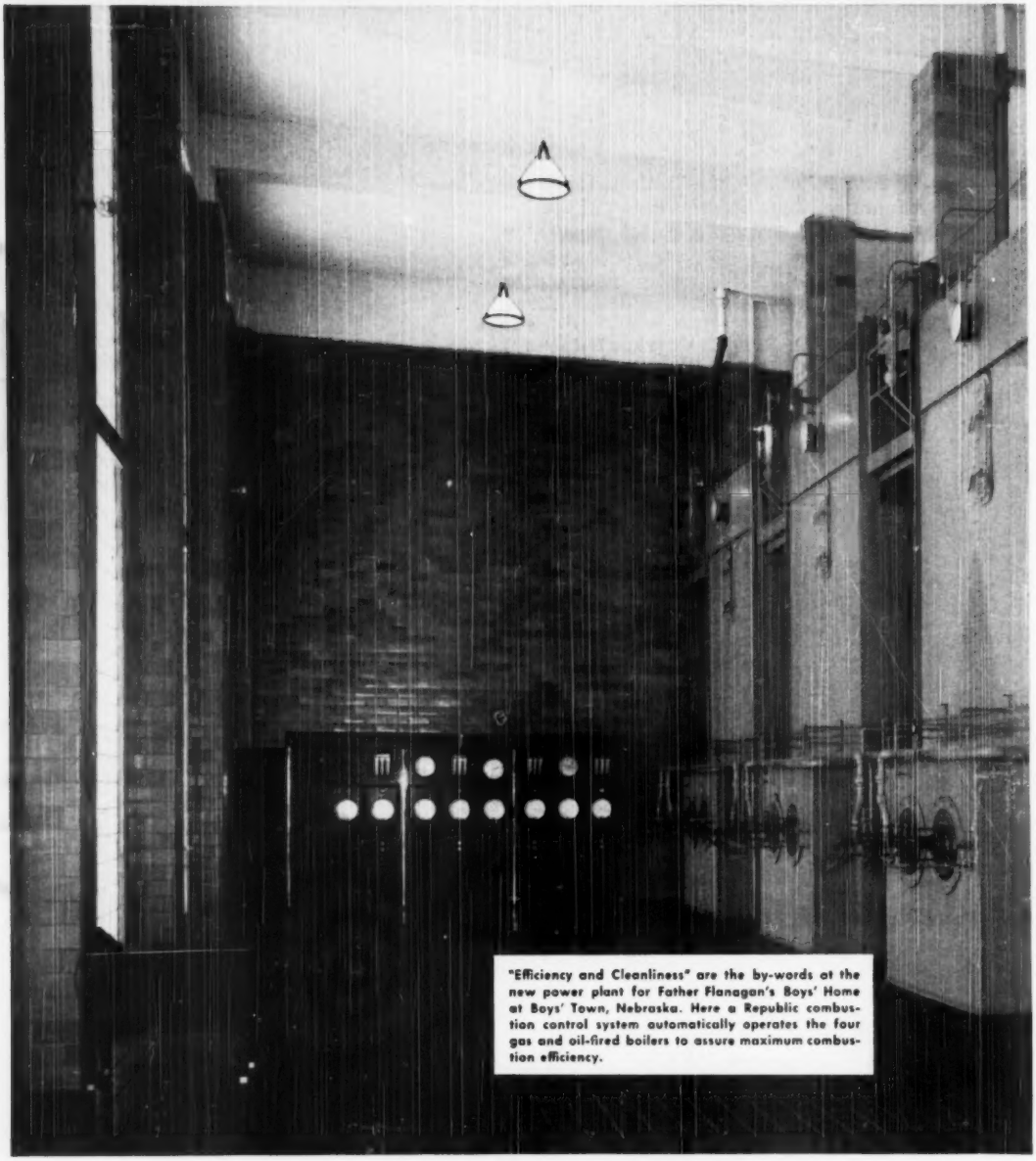


Each steam generator is equipped with two Foster Wheeler ball mill pulverizers which have a combined output of 27 tons of coal per hr.

FOSTER WHEELER

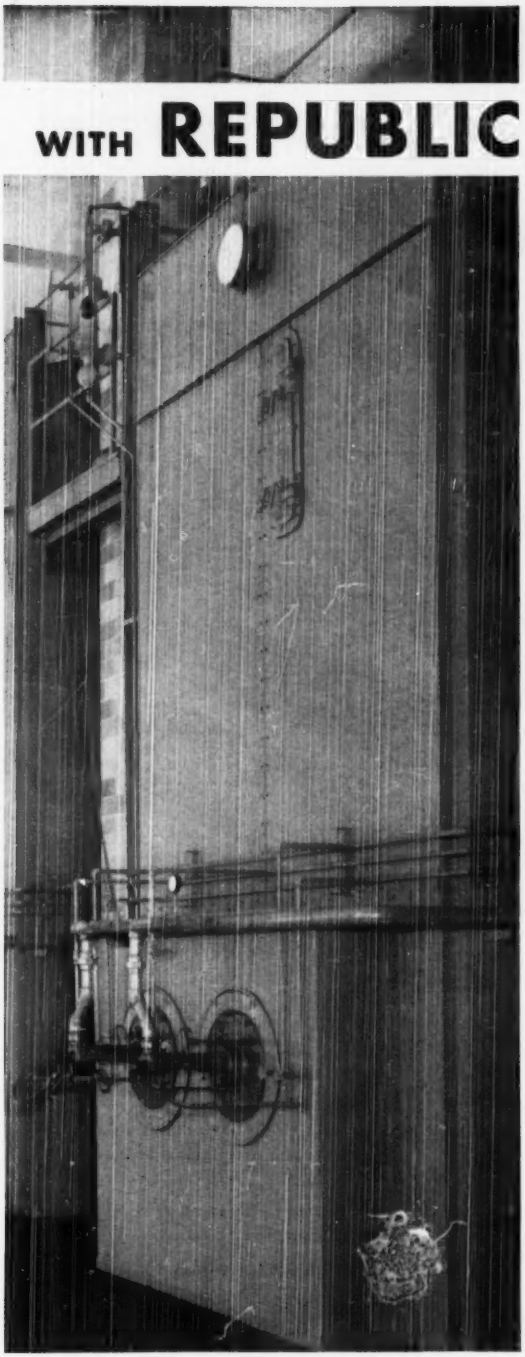
NEW YORK 6, N. Y.

More Steam FROM Less Fuel



"Efficiency and Cleanliness" are the by-words at the new power plant for Father Flanagan's Boys' Home at Boys' Town, Nebraska. Here a Republic combustion control system automatically operates the four gas and oil-fired boilers to assure maximum combustion efficiency.

REPUBLIC FLOW METERS CO.



WITH **REPUBLIC**

Automatic
COMBUSTION CONTROL

Low steam cost is not the result of efficient boiler design alone! It is determined by the degree with which your method of boiler control takes full advantage of those economies which have been "built in" your boiler and its auxiliaries.

In operating a modern boiler there are a number of repetitive adjustments which must be made frequently and practically simultaneously on several units of auxiliary equipment if highest boiler efficiency is to be maintained. The difficulty of making the required repetitive adjustments, accurately and simultaneously by hand at the individual auxiliaries, is obvious.

The REPUBLIC combustion control makes and co-ordinates these adjustments automatically, at the same time permits the operator to assume manual control from a centralized control point whenever necessary or desirable.

The REPUBLIC combustion control is a unified system controlling simultaneously, in measured quantities and in fixed (adjustable) proportions, the fuel and air input to the boiler. It increases and decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

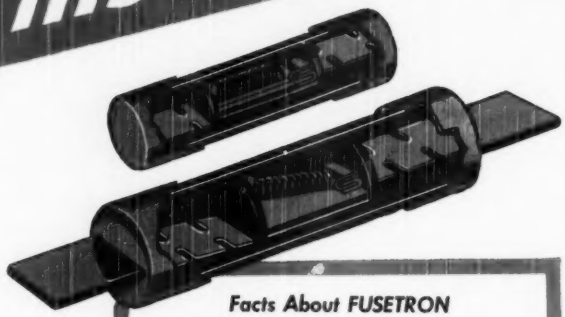
REPUBLIC combustion control systems are designed and built for all sizes of boilers — all types of fuel firing equipment — all load conditions. They fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of everyday operating requirements.

Ask for your copy of Data Book S-21.

2240 DIVERSEY PARKWAY
CHICAGO 47, ILLINOIS

"We stopped motor burn-outs and saved time and money for a large company..."

by Installing..



"Recently, while rewiring part of a large manufacturing plant here in Salem, we installed Fusetron dual-element fuses in motor-running protection size to back up the overload protection already installed on the motors.

"On several occasions, for some reason, these protectors failed to operate when they should have and the motor would have burned out except for the opening of the Fusetron fuses.

"The company's plant engineer was so impressed by the way these Fusetron fuses prevented damage to the motors and saved the company time and money that he authorized us to install Fusetron fuses throughout the entire plant."

Howard Firestone. Owner
FIRESTONE ELECTRIC COMPANY,
Salem, Ohio

Facts About FUSETRON Dual-Element Fuses

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprinsingly low.

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

Fusetron DUAL ELEMENT Fuses

with their

10 Point Protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

Stop Wasting Time and Money-

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

FUSETRON Dual-Element Fuses Give ALL-PURPOSE PROTECTION

One needless shutdown — or one lost motor — or one destroyed switch or panel — may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse.

Don't risk such losses — protect yourself by installing a FUSETRON dual-element fuse in every set of fuse clips throughout the entire electrical system.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

*Name*_____

*Title*_____

*Company*_____

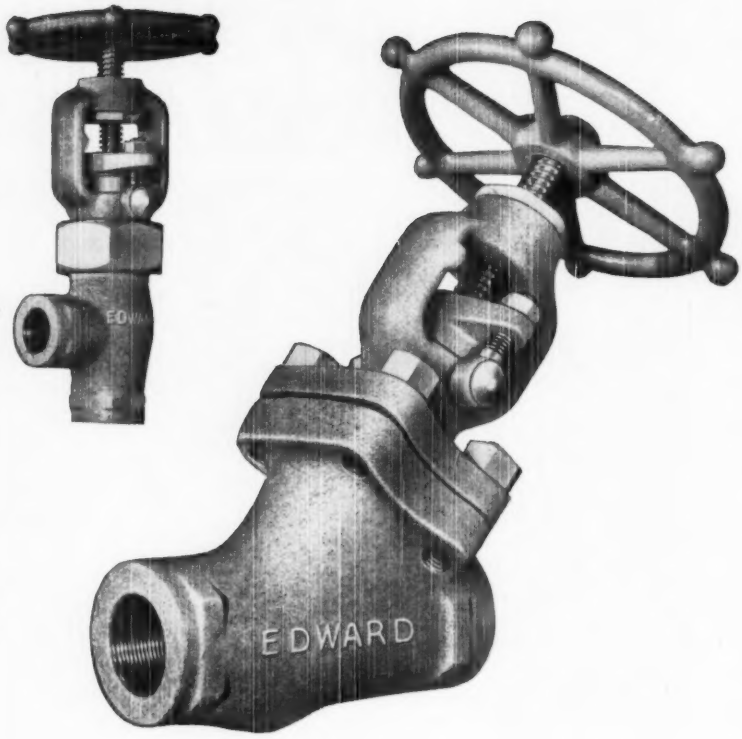
*Address*_____

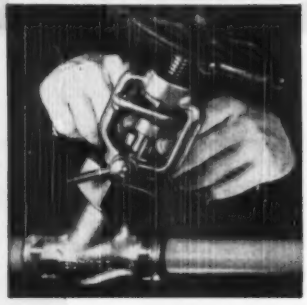
*City & Zone*_____ *State*_____ 150

Edward Presents

Here's a brand-new all-purpose valve series with unusually wide applicability—ideal for almost any service where small O. S. & Y. steel valves are used. Drop forged steel for greatest strength in high pressure or temperature service . . . the simplest packing arrangement imaginable . . . tight, easily accessible union or bolted bonnet joints . . . bronze yoke bushings to prevent stem galling or freezing . . . Microscopically mated seats and disks . . . lock welded parts to prevent loosening in service . . . EValpak heat-resistant molded premium type packing . . . interchangeability of parts for reduced maintenance inventories . . .

These and dozens of other features are standard in the new Edward Fig. 444 series, now available for stock shipments in most sizes, ¼ in. to 2 in. inclusive, either 600 or 1500 lb sp.





SIMPLICITY OF PACKING

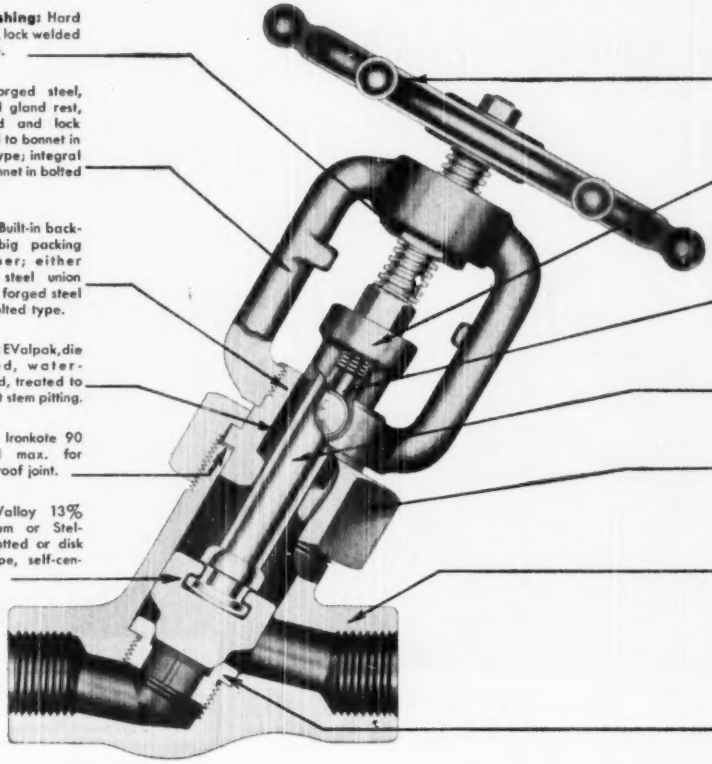
See how easy it is to repack the new Edward Fig. 444 series. Gland is held on special rests on yoke. Gland bolts swivel out of way, can't come off. Both hands are free to insert packing in generous space between stem and yoke. Pressure-tight backseating for repacking under pressure.

TIGHTEST SEAT-DISK JOINT

No valve is better than its seat-disk joint. All Edward Fig. 444 seats and disks are precision borized to identical angles in mated pairs, then tested on Edward built Micron-o-scope, measuring to .00025 of an inch, for absolute tightness and concentricity.

The All-Purpose Steel Valve!

NEW FIG. 444 SERIES!



Yoke Bushing: Hard bronze, lock welded to yoke.

Yoke: Forged steel, integral gland rest, screwed and lock welded to bonnet in union type; integral with bonnet in bolted design.

Bonnet: Built-in backseat, big packing chamber; either rolled steel union ring or forged steel stud bolted type.

Packing: EValpak, die formed, waterproofed, treated to prevent stem pitting.

Gasket: Ironkote 90 Brinnell max. for leak-proof joint.

Disk: EValloy 13% chromium or Stellite, slotted or disk nut type, self-centering.

Handwheel: Malleable iron, knobbed for easy gripping.

Gland: Forged steel, through bolted, accurately fitted to stuffing box.

Swing Gland Bolts: Forged steel, EValized for longer, corrosion-free life; swivel out of way but can't come off.

Stem: Hardened, centerless ground EValloy, with backseating shoulder (on disk nut on larger sizes).

Union Ring: Rolled or forged steel, hexagonal.

Body: Heat treated forged steel, inclined stem globe type for lowest pressure loss, screwed or socket welding ends.

Seat: EValloy 13% chromium or Stellite on stainless steel; borized in mated pair with disk.

EDWARD VALVES, INC.,
1220 West 144th St., East Chicago, Indiana.

Please send a copy of Bulletin 501 describing your new Fig. 444 all-purpose forged steel valves.

Name _____

Company _____

Address _____

City _____ Zone ____ State _____

NOW READY! New Bulletin 501 gives you dimensions, ratings, full data on the new Edward Fig. 444 series. Send coupon now for your copy.

Edward Fig. 444 series are built in sizes ¼ to 2 in. inclusive, globe or angle, screwed or socket welding ends, 600 or 1500 lb sp classes, in carbon or chromium molybdenum steel.

Another Product

Edward Valves, Inc.

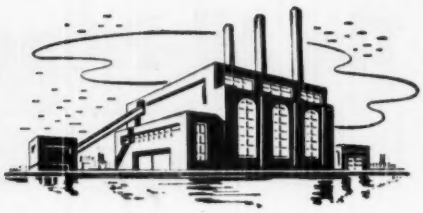
Subsidiary of ROCKWELL MANUFACTURING COMPANY

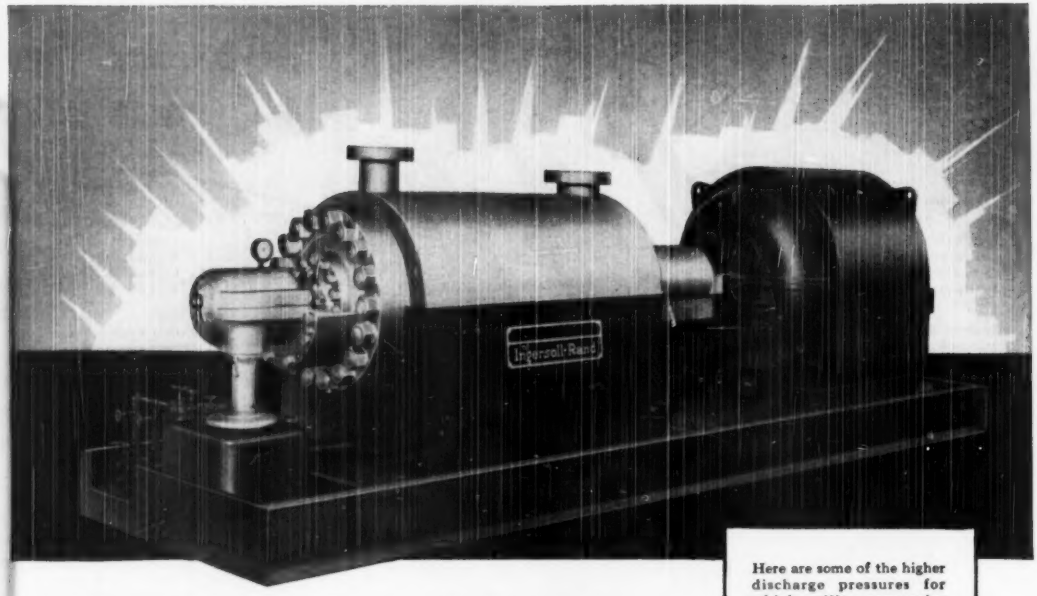
EAST CHICAGO, INDIANA

Here's one way to measure the

DEPENDABILITY

of Ingersoll-Rand Boiler-Feed Pumps





The overwhelming acceptance of I-R Boiler-Feed Pumps for high-pressure service speaks for itself

DEPENDABILITY is probably the most important single requirement in modern central station equipment. And that's why I-R double-case pumps are first choice for really high-pressure boiler-feed service. Their ability to pump feed water at discharge pressures as high as 2900 psi has been thoroughly proven by long, trouble-free service in many outstanding high-pressure installations. And over 40% of the I-R double-case pumps sold are on repeat orders—from users who have proved this dependability in their own plants.

Whatever the pressure, or the capacity, Ingersoll-Rand can supply the right boiler-feed pump constructed of the proper materials. Call your I-R branch office the next time you have a pumping problem.

Here are some of the higher discharge pressures for which utility companies have purchased I-R double-case pumps. Some of these pumps have been in service for as long as 12 years.

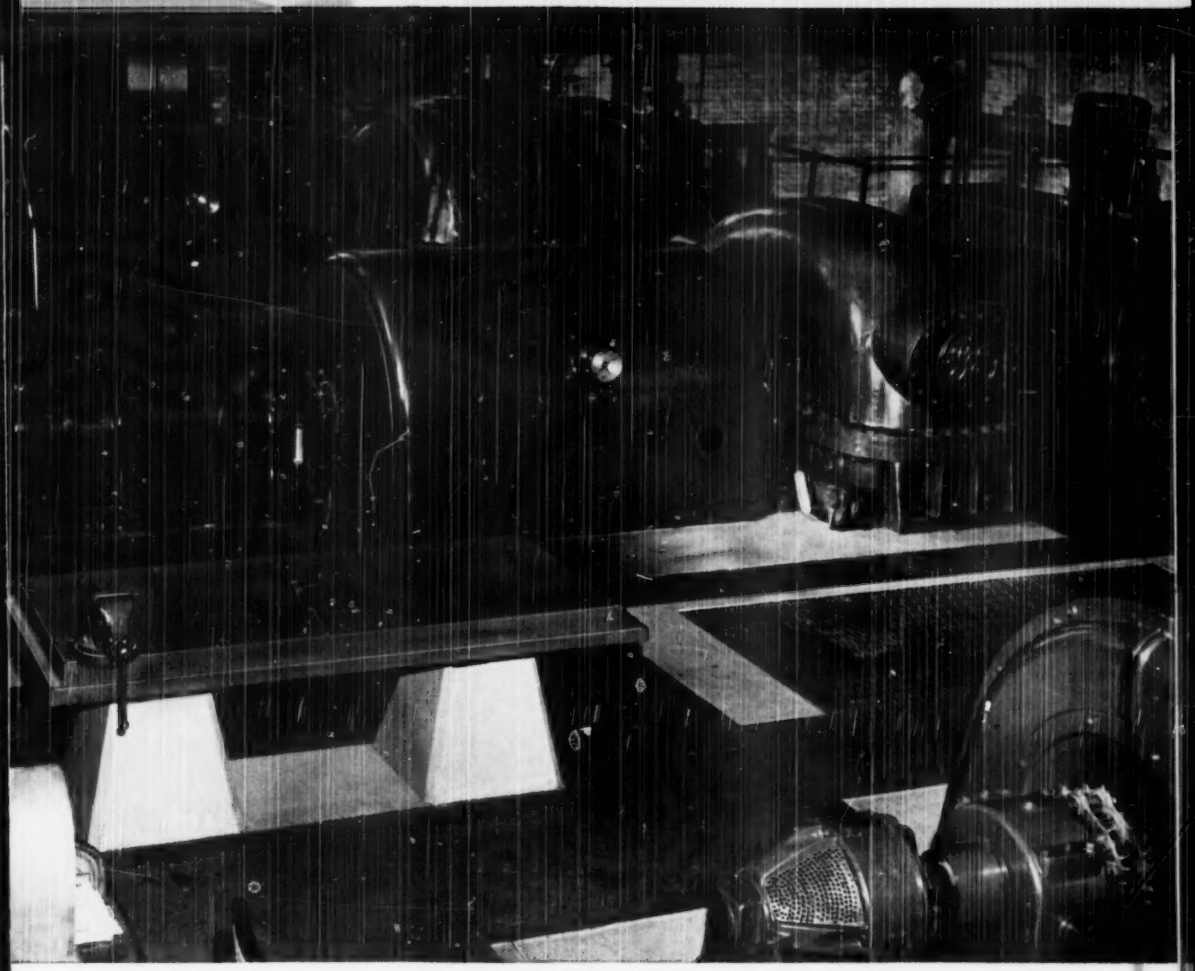
Pump Discharge Pressure PSIG	
2900	1850
2470	1845
2395	1800
2180	1795
1990	1750
1895	1745
1890	1725
1870	1700

Ingersoll-Rand

Cameron Pump Division 390-10

11 Broadway, New York 4, N. Y.

COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL AND GAS ENGINES



These turbine lubrication savings can be yours . . .

Simply by your choice of turbine oil, you can eliminate the cost, the time and the labor of replacing turbine oil. You can eliminate also the need for removing turbine oil for treating and the need for cleaning oil systems. Evidence that you can make these savings is supplied by S. H. Smith, superintendent of the Board of Public Works, South Haven, Michigan. He reports:

"When the first of our three present turbines was installed in 1936, we filled it with Nonpareil Turbine Oil. This practice was followed with each of the other two turbines. *In 13 years' use of Nonpareil, we have had no shutdowns resulting from dirty oil or from the necessity of replacing oil.* It has not been necessary to clean the oil. Semi-annual tests have shown that the oil has not deteriorated in any way."

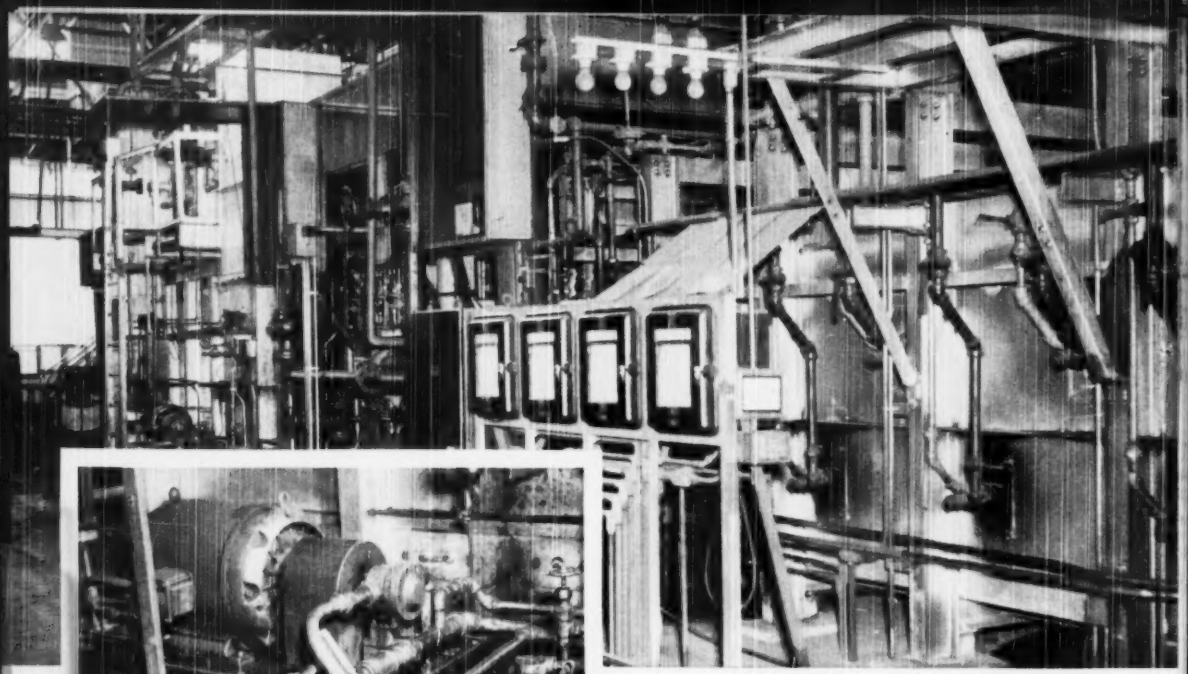
Your switch to Nonpareil Turbine Oil will insure safe and economical lubrication, not only for 13 years, but for the *life* of your turbines. You receive with each fill of Nonpareil a written guarantee that the oil will last as long as the turbine and that its acidity will stay below a neutralization number of 0.15 mg. KOH/gm. Find out from a Standard Oil Lubrication Engineer how Nonpareil has lived up to its guarantee, how it has reduced utility lubrication costs as much as 68%.

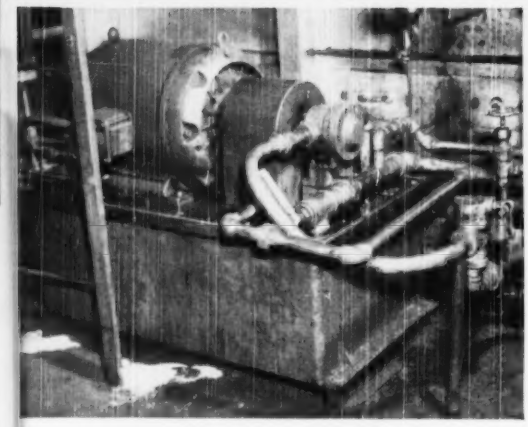
NONPAREIL
Turbine Oil

"WILL OUTLAST YOUR TURBINE"

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD





STANOIL
Industrial Oil

How to make your hydraulic operations more reliable

EQUIPMENT like that shown above is used for hardening automotive crankshafts in a midwest plant. Each unit consists of a hardening furnace and an automatic quench tank. Hydraulic units, operating through panel control boxes, move the crankshafts through the furnaces and tanks at prescribed depths and at fixed time cycles.

Because of manufacturing requirements, hydraulic units must operate continuously without shutdown for cleaning. At the same time, they must function perfectly to permit accurate control of furnace operations.

Stanoil 15 has enabled the hydraulic units to meet fully these two stringent demands. There have been no difficulties due to stuck valves. The hydraulic units have responded smoothly and promptly to controls. Oil systems have remained clean and free from deposits.

You can rely on Stanoils to give you the same clean, dependable operation of hydraulic units and of speed reducers and circulating systems as well. These unique, multi-purpose oils can replace many special and costly oils in your plant. A Standard Oil Lubrication Engineer will be glad to help you obtain the most economical use of Stanoil.

If your plant is located in the Midwest, write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, to secure the services of the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD

EXPERT, DEPENDABLE, CONVENIENT
Motor Repair Service

Typical Allis-Chalmers Certified Service Shop — Electric Apparatus Repair Company, Philadelphia — is equipped for big emergency jobs ... gives fast, personalized service on every day maintenance and repair.

WHEREVER your plant is located — from Boston to San Diego — you can get prompt, skillful motor repair service from a nearby Allis-Chalmers Certified Service Shop. These shops, selected for their reliability and excellent repair facilities, now cover every major industrial area in the country.

When you need work done on motors, transformers or control — when you're looking for a shop that can help you cut lost production hours and get you rolling again, fast—call the A-C Certified Service shop nearest you.

These shops are hand-picked from the best independent shops in your locality. They meet exacting A-C standards — use factory-approved methods and parts to assure like-new motor performance.

Need Repairs? New Motors?

For expert service — for new motors from ½ to 25,000 hp — give your nearest A-C Authorized Dealer or Sales Office a call!

A-2838

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE. WIS.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

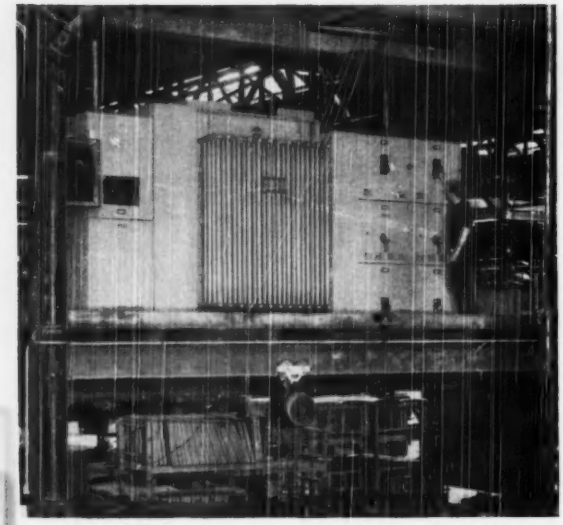
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

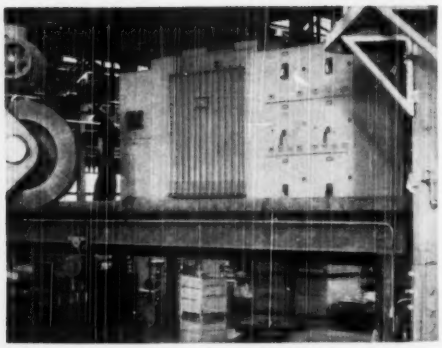
TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS



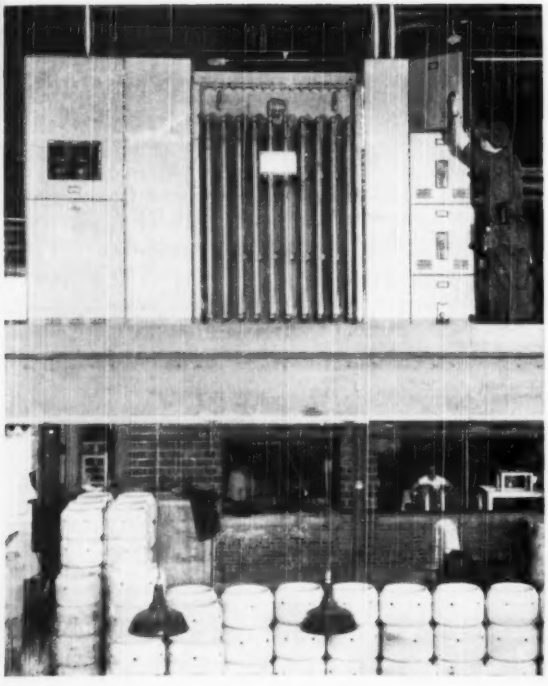


ALL UNIT SUBSTATIONS MOUNTED ON PLATFORMS TO SAVE FLOOR SPACE

Two views of General Electric 1000-kva load-center unit substation at new Maytag plant. Valuable manufacturing space is saved by locating units on platforms under the roof, right over the center of the load area. Air switch on primary is easy to operate, contacts are easy to see. Air circuit breakers on secondary are of the drawout type, easily removable for inspection and maintenance. Note entire load center is metal enclosed, thus offering operating safety to personnel.

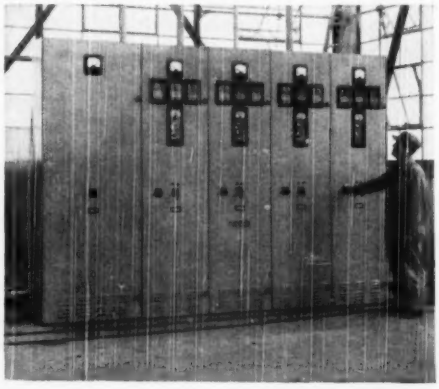
LOAD-CENTER

UNIT SUBSTATIONS

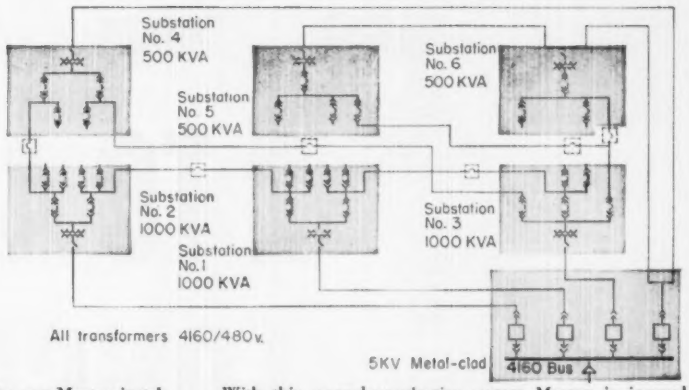


Unit substation No. 5, rated 500 kva. Air circuit breaker for future circuit can be inserted in empty upper housing. Drawout breakers are G-E Type AK-1 with 25,000 ampere interrupting rating—plenty of "IC" (Interrupting Capacity) to handle all short circuits. Contacts of 5 kv air switch are clearly visible through window, another safety feature of G-E substations.

G-E 5-kv metal-clad switchgear handles 4160 volts incoming power, distributes it to six load-center unit substations where it is stepped down to 480 volts for utilization. Metal-clad switchgear is neat in appearance, saving in space, and offers safety to operating personnel. Additional sections can be added for future expansion with a minimum of bother and expense.



CONTINUOUS POWER ASSURED MAYTAG BY SECONDARY-SELECTIVE DISTRIBUTION SYSTEM



This secondary-selective system at the new Maytag installation uses General Electric metal-clad switchgear to handle the incoming 4160 volts through four magne-blast power circuit breakers. Feeders distribute the 4160-volt power to six G-E load-center unit susbstations throughout the building where the high-voltage is stepped down to 480 volts for utilization—right at the center of the load area. This eliminates long, costly secondary feeders. Air switches on the primary of all load centers are rated 5 kv. Key interlocks give operating safety to personnel by preventing breaking of the load current with the air switch, or paralleling transformers.

With this secondary-selective system Maytag is insured against a power shutdown in case of failure of any one transformer or its primary feeder cable. If trouble occurs the normally open tie breaker is closed, thus providing an alternate source of power that permits the plant to operate at slightly reduced capacity.

The Maytag installation is a complete General Electric project—one source of responsibility plus the very best in coordinated planning, engineering, manufacturing, and service facilities to give maximum savings and efficiency to the customer.

HELP SPEED PRODUCTION AT THE NEW *Maytag* PLANT AT NEWTON, IOWA

ONLY G-E LOAD CENTERS GIVE YOU THESE FEATURES . . . .

SELECTED STANDARD ratings have been introduced by General Electric to bring you load centers on 20 per cent shorter shipments. The most popular are—

Low voltage	480 △ or Y, 208Y/120 volts
High voltage	2.4, 4.16, 4.8, 12, 13.2, 13.8 kv, delta
Kva ratings	300, 500, 750, 1000, 1500, 2000

Certain other *selected standard* load centers are available. Contact your G-E sales representative for further information.

NEAT APPEARANCE . . . Note the smooth, integrated appearance of these G-E unit substations . . . no more gawky, "old-type" stovepipe connections between transformer and switchgear.

SAVE TIME by eliminating weeks spent over drawing boards detailing individual items. G-E factory-assembled unit substations are quickly and easily installed with lower material and labor costs than required for "piece-meal," makeshift affairs. No last minute "alterations" with hacksaws and cold chisels to make them fit.

INVESTIGATE TODAY how General Electric unit substations can be used in your plant for efficient, flexible power distribution. Contact your G-E sales representative for further information, and write today for the helpful bulletins listed below. *Apparatus Department, General Electric Company, Schenectady 5, New York.*

GEA-3592 Load-center Unit Substations
GEA-3758 Load-center Power Distribution
GEA-3083 Metal-clad Switchgear
GEA-4057 Interlocked-armor Cable for Primary Circuits
GEA-4352 Flamenol Cable for Secondary Circuits

"For our new plant that manufactures Maytag automatic washers, we wanted the very best in power distribution systems. That's why we chose a secondary-selective system using General Electric load-center unit substations. We found that a system such as this would be more economical than any other type. Even though the initial cost was slightly higher than a simple radial system, the fact that we were assured of continuous power for our manufacturing facilities, even though a transformer or feeder cable should drop out, meant that we would save time and money in the long run. We also chose a load-center system because we can easily expand it to take care of any increase in our manufacturing facilities. We also bought 'standard' unit substations because we discovered they would do the job just as well as 'specials'—and at far less cost—and because we could get better delivery. After the units arrived they were installed on the platforms and were operating in a very short time. And dealing with one organization saved us time and money because we could get the engineering, equipment, and service all from one reliable source."

L. C. McAnly, Sr., Manager of Manufacturing,
The Maytag Co., Newton, Iowa

Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

GENERAL ELECTRIC

2 TO 4 TIMES LONGER LIFE WITH THE STURTEVANT E-R WHEEL

UNIT
AIR CONDITIONERS

REFRIGERATION
COMPRESSORS

Everything that puts air to work for Every application

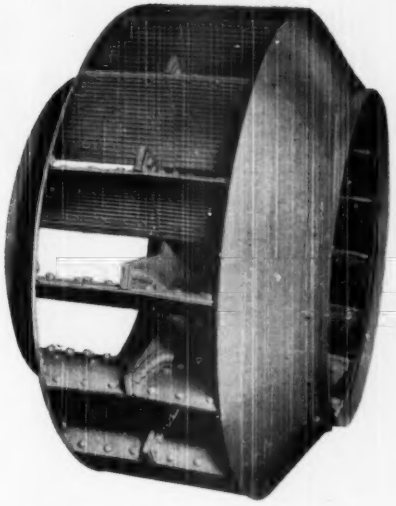
INDUSTRIAL FANS

UNIT HEATERS

VANE CONTROL®

J-80153

NO OTHER INDUCED DRAFT FAN CAN EQUAL THE PERFORMANCE OF THE STURTEVANT EROSION RESISTING WHEEL



Here's why:

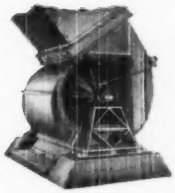
1 Erosion of blade surfaces is sharply reduced by cut-away center support design. Streams of fly-ash meet—and dissipate their abrasive action on each other instead of on the wheel surface.

2 Fewer blades and absence of tie rods mean less obstruction to flow of fly-ash and less surface exposed to eroding action. Efficiency is high.

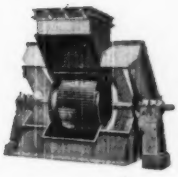
3 **Full** blade liners are easily and quickly renewable, and can be welded locally when wear is concentrated. Wheel life is prolonged, maintenance costs cut and outage losses minimized.

Many years of service in hundreds of installations have proved conclusively that the E-R Wheel is the soundest investment you can make in induced draft equipment. You get this wheel in the highly efficient Sturtevant Turbovane® Induced Draft Fan. And it may be that your present fan can be modernized with the E-R Wheel. Ask your nearest Sturtevant office, or write Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

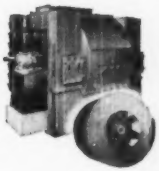
Westinghouse
Sturtevant Division



FORCED DRAFT FANS
(Turbovane®)



INDUCED DRAFT FANS
(Multivane®)

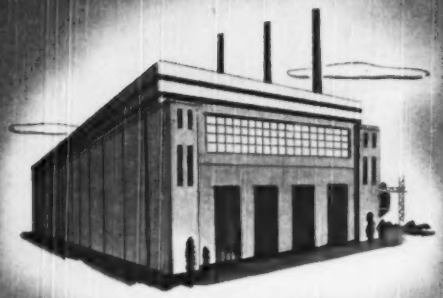


INDUCED DRAFT FANS
(Steel Plate)

INDUCED DRAFT FANS
(Turbovane®)

Whatever the Steam Requirements

ELECTRUNITE



POWER GENERATION

INDUSTRIAL PROCESSING

GENERAL HEATING

TYPICAL POST-WAR INSTALLATIONS IN WHICH ELECTRUNITE BOILER TUBES WERE USED AS ORIGINAL EQUIPMENT

CORNELL UNIVERSITY . . . . Ithaca, New York
SLOANE-BLABON CORPORATION
Trenton, New Jersey
INTERNATIONAL HARVESTER COMPANY
Chicago, Illinois
MID-CONTINENT PETROLEUM CORPORATION
Tulsa, Oklahoma
GENERAL ELECTRIC COMPANY . . . Lynn, Mass.
MANHATTAN SOAP SALES CORPORATION
Bristol, Pennsylvania
SWIFT AND COMPANY . . . Hammond, Indiana
KENNECOTT COPPER CORPORATION
Heyden, Arizona
GILBERT PAPER COMPANY, Menasha, Wisconsin
MORTON SALT COMPANY, Manistee, Michigan
WORCESTER GAS AND LIGHT COMPANY
Framingham, Massachusetts
MISSOURI POWER AND LIGHT COMPANY
Mexico, Missouri
NORTHERN STATES POWER COMPANY
Redwing, Minnesota
CENTRAL ILLINOIS LIGHT COMPANY, Peoria, Ill.
PUBLIC SERVICE COMPANY OF INDIANA
Edwardsport, Indiana
UNION ELECTRIC COMPANY OF MISSOURI
St. Louis, Missouri
CITY OF PROVO, UTAH
OTTER TAIL POWER COMPANY . . . Devils Lake, N. D.; Wahpeton, N. D.; Crookston, Minn.
CHRYSLER CORPORATION . . . . Dayton, Ohio
SCOVILLE MANUFACTURING COMPANY
Waterbury, Connecticut

. . . It Pays to Specify

BOILER TUBES

Here's why: As made by Republic's advanced process of tube manufacture, ELECTRUNITE Boiler Tubes give you valuable, cost-cutting installation advantages . . . plus assurance of dependable, uninterrupted boiler operation.

In this process, clean, flat-rolled steel is cold-formed into tubular shape and electric-resistance welded into strong, sound tubing. Full Normalizing in modern controlled atmosphere furnaces, provides uniformly high ductility throughout every length. Hydrostatic testing affords final proof of dependable top quality, unvarying throughout every shipment.

The result: Modern boiler tubes that bend easily, slide through tube sheets freely, expand smoothly, and bead over to tight, non-leaking joints in a hurry. Actual installation records indicate time savings as high as 30% for ELECTRUNITE Boiler Tubes over ordinary tubes.

A few of the many post-war installations of ELECTRUNITE Boiler Tubes are shown at the left. For additional information about any of these, or specific data regarding your own boiler installations, write today to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

Fast installation is only part of the ELECTRUNITE story. Once installed, these modern scale-free boiler tubes have what it takes to stand up under the most severe operating conditions . . . furnishing long years of maintenance-free service.

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

You *specify* the service..

This may sound like a broad statement, but we can prove it. Because of the completeness of the Powell Line, we are always able to supply the *right* valves to meet the requirements of every industrial flow control service.

You specify the conditions under which the valve must operate. Usually your Powell distributor will know which is the right Powell Valve to meet them. If the conditions present a problem he can always consult Powell Engineers, or if you prefer, write to us direct.

At all events be sure you install the *right* valves—it's easy to do with the Powell Line.* Failure to do so will mean faulty performance instead of the long, trouble-free operation you can expect from the right Powell Valves.

Fig. 11313 W. E. — Class 1500-pound Cast Steel Pressure Seal Gate Valve with welding ends, venturied ports and special by-pass. Bevel gear operation. Also available with top-mounted, electric motor operator.

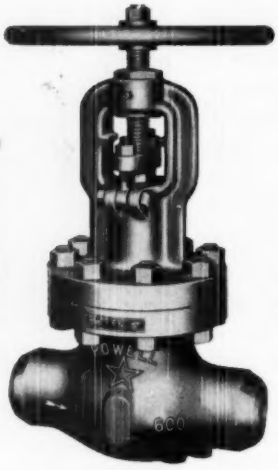


Fig. 6031 W.E.—Class 600-pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke.

Fig. 1331-A—Class 1500-pound Steel Integral Bonnet Offset Globe Valve with welding ends. Also available in Angle and "Y" patterns.

Fig. 1793— Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", incl. Has outside screw rising stem, bolted flanged yoke, tapered solid wedge.

POWELL

We'll *supply* the RIGHT valve

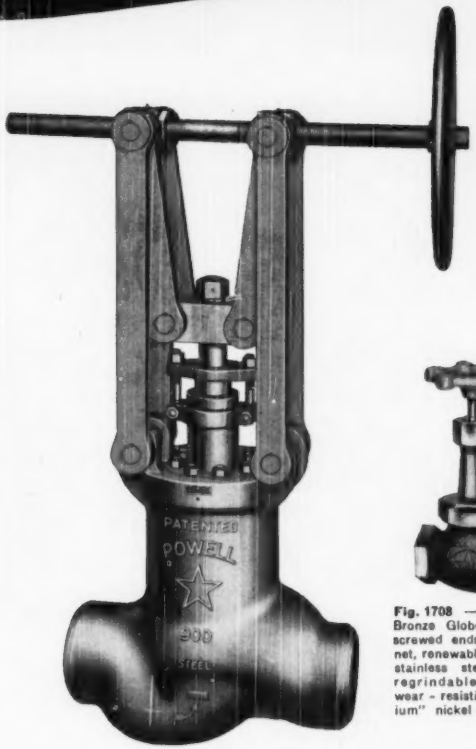


Fig. 19084 W. E.—Class 900-pound Cast Steel Pressure Seal Globe Non-Return Valve with welding ends and toggle operation. Improved streamline design reduces pressure drop and turbulence to the minimum.

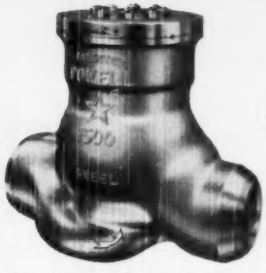


Fig. 11365 W.E.—Class 1500-pound Cast Steel Pressure Seal, Piston-Guided, Horizontal Lift Check Valve, with welding ends. Streamline design permits maximum flow through valve with minimum pressure drop.

Fig. 1708 — 200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable heat treated stainless steel seat and regrindable, renewable, wear-resisting "Powell-ium" nickel-bronze disc.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

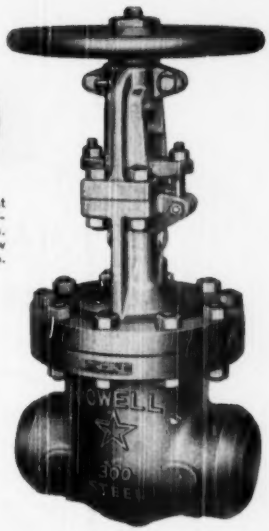


Fig. 3003 W. E.—Class 300-pound Cast Steel Gate Valve. Welding ends, bolted flanged yoke, outside screw rising stem, tapered solid wedge.

*** Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.**

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The Wm. Powell Company, Cincinnati 22, Ohio

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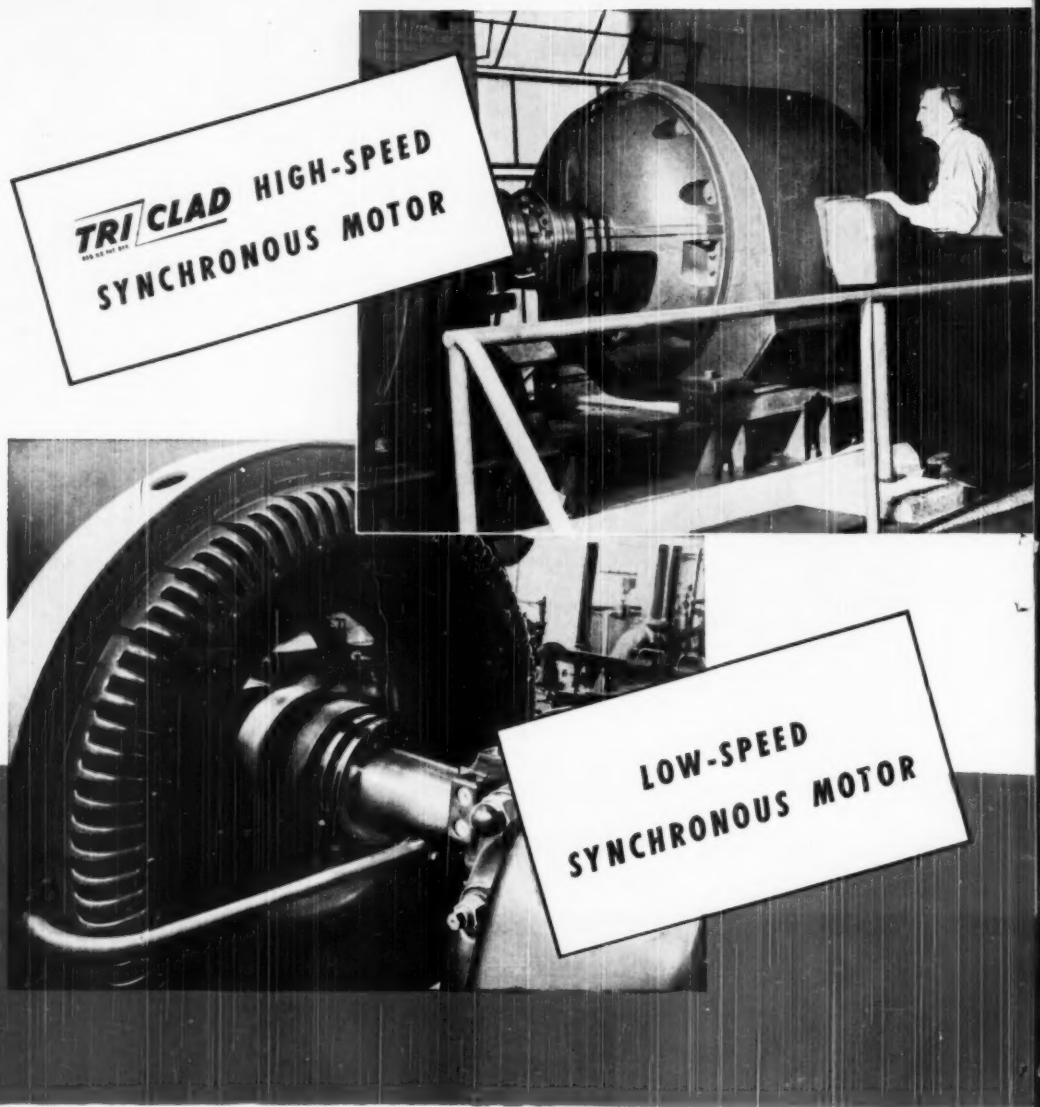
VALVES

SAVE

on operating costs



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SYNCHRONOUS MOTORS PAY THEIR OWN WAY

Yes, in certain applications a synchronous motor is cheaper to operate because it is more efficient than other electric motors.

Here's an example:

Compare a 200 hp, 2300 volt, 900 rpm synchronous motor with another type of motor of the same rating. Actual testing shows that the synchronous motor including its exciter loss is around 94% efficient while the other motor is about 92% efficient. The two per cent gain by the synchronous motor looks small but in this instance, where the motor operated sixteen hours a day, it meant a $200.00 annual saving in power costs, based on a $.01 per kwh power cost.

Your General Electric salesman can point out many applications where **synchronous motors have a lower initial cost** in addition to **lower operating cost.**

REMEMBER—Efficiency pays off in dollars and General Electric synchronous motors give you increased efficiency, in many instances at **lower first cost.**

Don't think of buying your next motor without seriously considering the application of **money-saving synchronous motors** in your plant. Call your G-E salesman right now, he has good news for you. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

G-E SYNCHRONOUS MOTOR CONTROL GUARDS EFFICIENCY

The new G-E synchronous motor control provides the accurate adjustments that enable you to improve power factor—increase efficiency. Here's where details count—where the slightest variation of a pointer on a meter means money saved—or lost. New meter design prevents any possibility of misreading the scale.

The new, smaller rheostat, too, has design features that not only result in longer life, but in greater operating convenience and accuracy. You can be sure, too, that the new field circuit will respond instantly to rheostat adjustment.

Steel cabinets not only protect personnel and equipment, but are designed to line up with other G-E power units such as switchgear, thereby improving plant appearance.

Ask your nearest G-E office for more information about this equipment that safeguards your investment . . . helps save on operating expenses.

GENERAL ELECTRIC

Apparatus Dept., Sec. E770-8,
General Electric Company
1 River Road, Schenectady 5, N. Y.

Gentlemen: I would like more information on the advantages of synchronous motors. Please send me the indicated descriptive literature.

Low Speed	*High Speed*	*Control*
☐ GEA-529D	☐ GEA-5113	☐ GEC-505

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Company .....

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City ..... State .....

A NEW REFRIGERATION CONDENSERS BOOKLET BY Vogt

Write FOR BULLETIN RC-1

Here's pertinent, up-to-the-minute information on our complete line of refrigeration condensers . . . a 24 page booklet showing types and sizes designed to deliver low temperature liquid with the lowest condensing pressure.

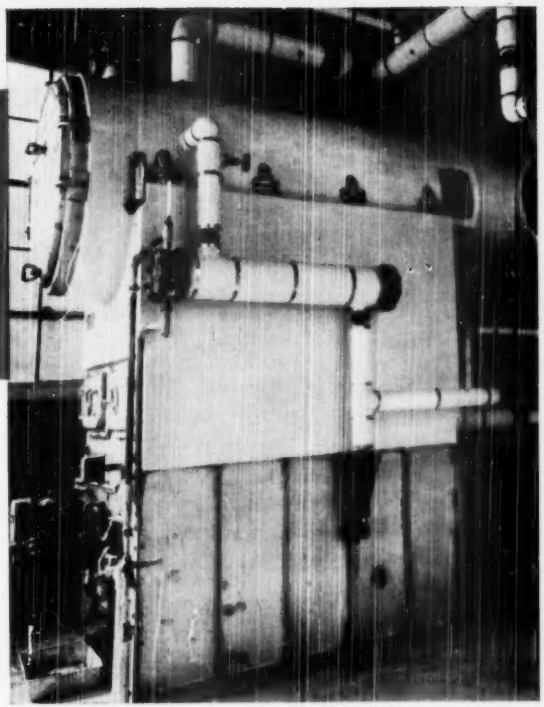
Vogt Refrigeration Condensers are fabricated from top quality plates, tubes, pipes, forgings, and castings by skilled workmen in modernly equipped shops. Units are designed, tested and stamped to A.S.M.E. Code requirements.

Vogt FOR BETTER REFRIGERATION

HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS

How would you insulate this boiler?



The steel shell of this oil-fired hot water boiler is heated to 250° F. Which of these insulating materials listed below is most practical?

1. 85% Magnesia block
2. Air cell block
3. Mineral wool blanket

HERE'S WHAT THE ARMSTRONG ENGINEER RECOMMENDED:

All too often, small boilers waste a needless amount of fuel. In most cases the blame rests squarely upon the insulation job. Because equipment of this type operates at low pressures and temperatures, many owners seem to be satisfied that their boilers are "insulated" if they have a coat of something white over the surface.

These inadequate insulation jobs are done to cut initial costs. But the savings are always small when compared to the year-after-year extravagance of excessive heat losses.

All three of the insulations listed above will do an adequate insulating job if they're applied in the proper thicknesses, firmly wired in place, and finished with asbestos cement.

From a practical point of view, 85% Magnesia block offers the best solution. Blocks can be quickly wired on and they provide an even surface for the finish. Air cell, while adequate insulation for the low temperatures involved, is more fragile than 85% Magnesia and will not hold up so well in long service. Mineral wool blankets are large and unweildy on an installation as small as this, running up labor costs.

In the heat insulation field, the low initial cost job may be the most expensive in the long run. No matter how large or small a job may be, there's one way of doing it that will bring you the greatest return for your investment. Armstrong engineers can recommend that way to you. The complete contracting service they represent also offers you quality insulating materials and expert workmen to apply them.

FREE BOOKLET

Send today for the new booklet, "Armstrong's Industrial Insulations." It describes completely the materials and services offered to users of insulations for all temperatures. Write today to Armstrong Cork Company, 7001 Maple Avenue, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

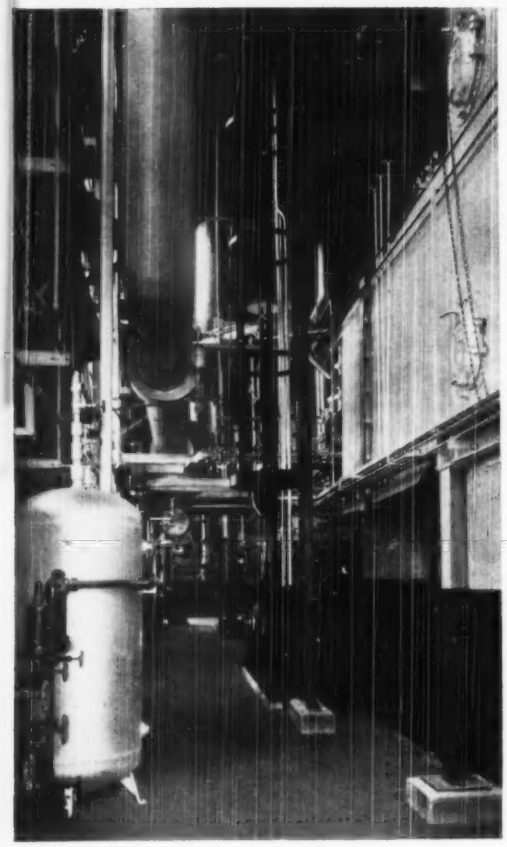
MATERIALS (A) INSTALLATION

FOR ALL TEMPERATURES FROM 300° F. BELOW ZERO TO 2800° F.

Automatic Combustion Control... Ring Balance

. . . by HAGAN, *at the*

Recent expansion of the refinery of Gulf Refining Company at Cleves, near Cincinnati, included the installation of two new boilers, each with a capacity of 70,000 pounds of steam per hour, and operating at 685 psi. Fuels used are refinery waste gas and oil, either singly, or in combination.



General view showing front of boilers and instrument panels in Gulf Refining Company refinery at Cleves, Ohio.

These new boilers are equipped with Hagan Automatic Combustion Control, Hagan Automatic Feedwater Regulation, and Hagan Ring Balance Meters.

The combustion control is a Hagan Differential Master system. With this system, waste gas is burned when available and is automatically supplemented or replaced by oil as necessary. Fuel feed is changed instantly to compensate for fluctuations in calorific value of fuel or changes in steam demand and excess air is automatically maintained in accordance with actual Btu input.

Hagan Automatic Feedwater regulation is a multiple circuit system which proportions feed water to steam flow and modifies feedwater flow in accordance with water level in the boiler. Thus this system not only holds water level accurately in a steady steaming state, but also "irons out" in an optimum pattern, the mutual disturbances which exist between the steam generating circuits and the water flow circuits of the boiler in changing from one steam rate to another.

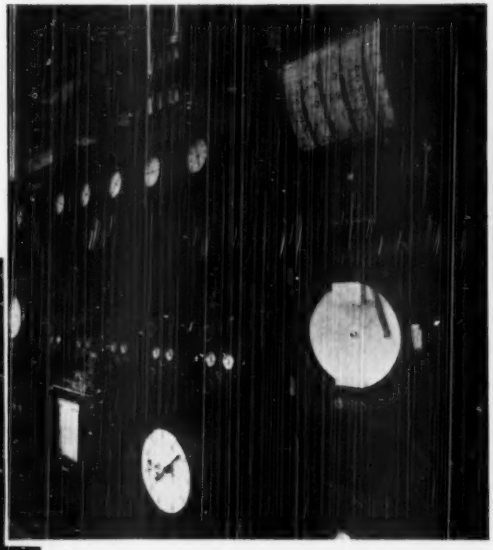
Two Hagan Ring Balance Meters are used with each boiler. One records steam flow, air flow and

Meters . . . Automatic Feedwater Regulation

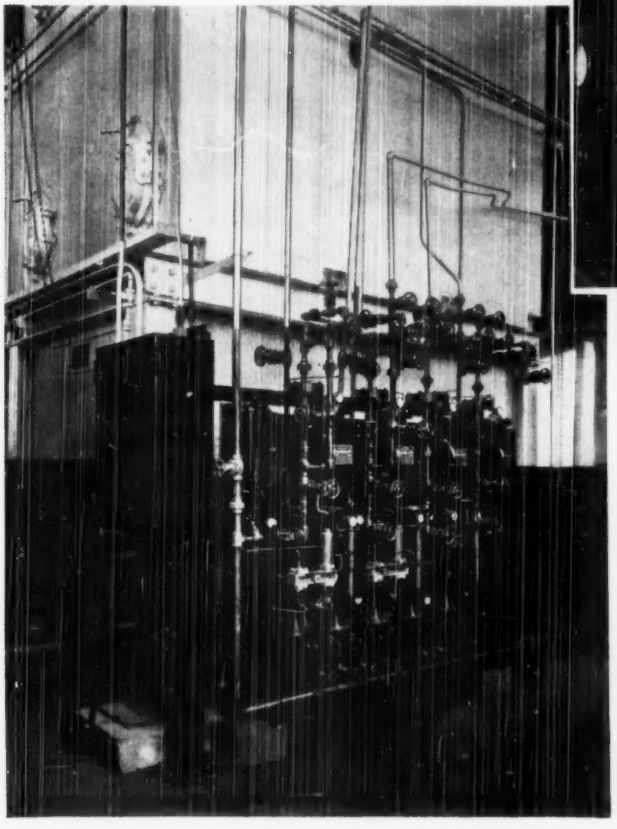
CLEVES, OHIO, REFINERY OF GULF REFINING COMPANY

steam pressure; the other records feedwater flow and steam drum water level.

We will be glad to supply full information on Hagan Combustion Control, Hagan Automatic Feedwater Regulation and Hagan Ring Balance Meters. Write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.



▲ *Separate instrument panels are provided for each boiler. Two Hagan Ring Balance Meters are mounted on each panel.*

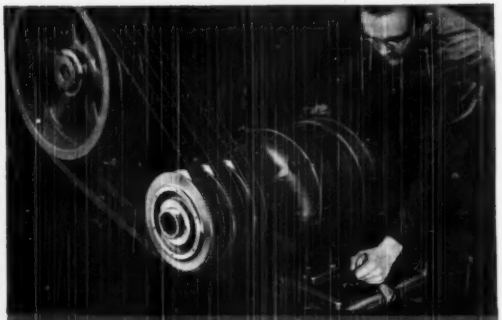


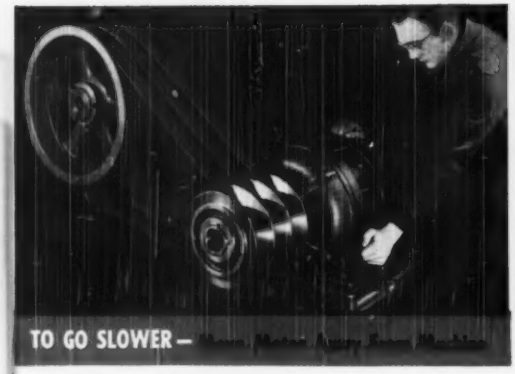
HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

◀ *Components of the Hagan automatic feedwater regulation and combustion control systems are mounted at the side of each boiler, giving easy access for adjustment or servicing.*

Vari-Pitch
AUTOMATIC
SHEAVE





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Control Machine Speed

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NOW YOU CAN HAVE all the advantages of instant speed control on all your machines at very low cost and without installing intricate and expensive mechanisms. You can increase production by setting operating speeds at exactly the right tempo for highest production. You can improve quality, change to new materials, all at the twist of a wrist.

All this is made possible by the *new Vari-Pitch* Automatic Sheave which changes pitch diameter and holds proper belt tension *automatically*. Today, ask your A-C Authorized Dealer or Sales Office to give you complete facts and figures on how the new *Vari-Pitch* Automatic Sheave can save money in your operations. Or write for Bulletin 20B7223. A-2837

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MOTORS — ½ to 25,000 hp and up. All types.

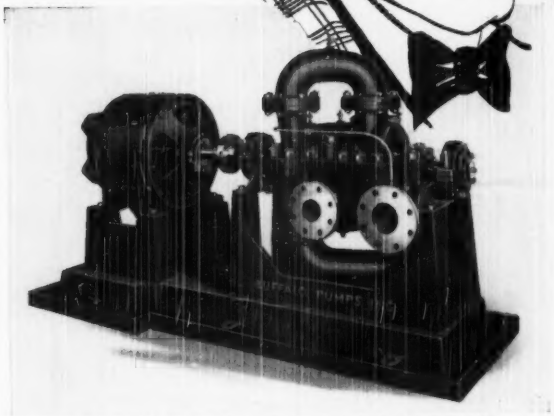
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

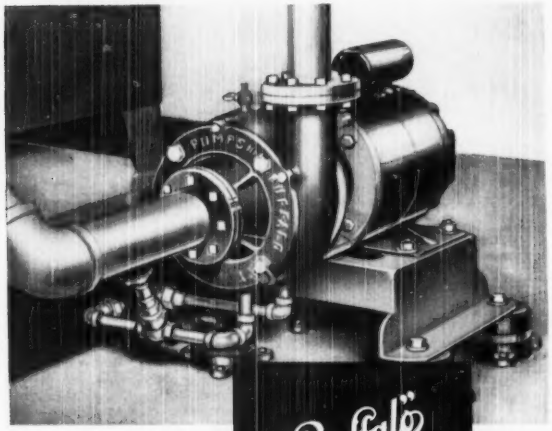
ALLIS-CHALMERS

ECONOMY

THE INEVITABLE RESULT OF TROUBLE-FREE "Buffalo" PUMP PERFORMANCE



"Buffalo" Class "RR" Pump for Boiler Feed and Other Clear Water Service.



"Buffalo" No. 1½ CCS Close-Coupled Pump Circulating Water for Air Conditioning.

"Buffalo" CENTRIFUGAL PUMPS FOR EVERY SERVICE

Ask anyone who has used pumps a good long while—he'll say the ECONOMICAL pump is the one you can practically ignore! It not only saves on repair bills, but on expensive time-outs where plant functions depend on pumping.

If you want this major economy, specify "Buffalo" for your next pumping job. "Buffalo" construction—impellers, bearing stands, shafts, casings and stuffing boxes—makes no compromise with quality. Add to this the economy of high-efficiency performance—and the inevitable result of owning a "Buffalo" Pump is economy that adds up through the years.

Call in your "Buffalo" engineering representative, or write us for complete information.

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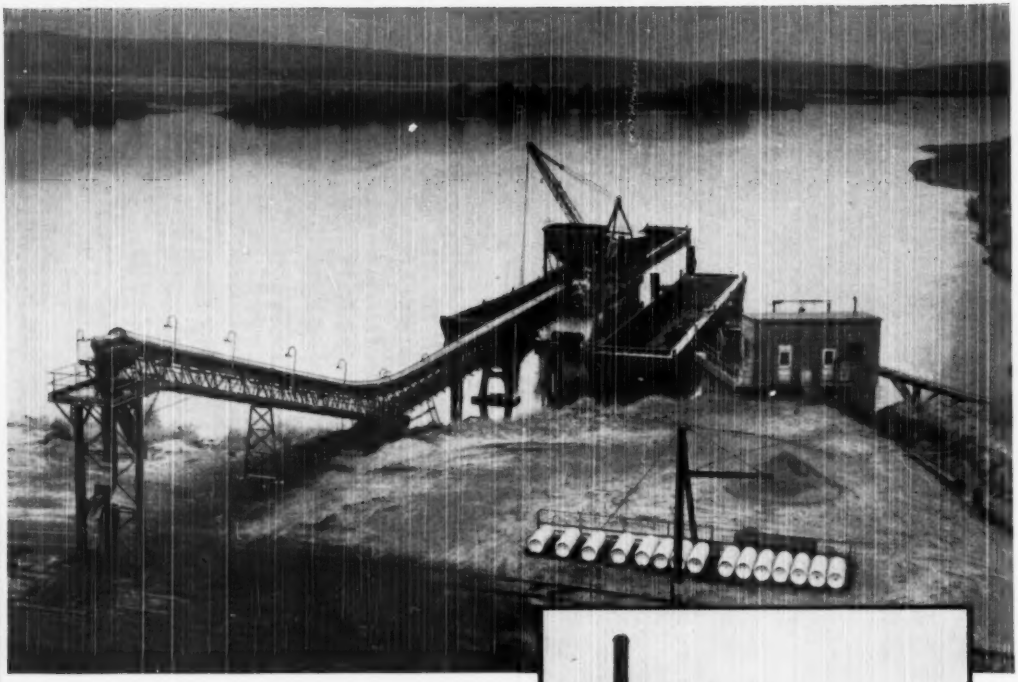

Barges to Bunkers —No Hands!

In this case, coal had to move from river barges and rail cars to storage bunkers in the power house. Outdoor storage with conveying equipment to quickly reclaim coal was also a must. A single system had to do the job fast at lowest cost per ton. An S-A engineered system is easily meeting every requirement.

S-A engineers draw upon almost half a century of experience in bulk materials handling. In almost every kind of industry, they are continually designing and installing systems that increase the efficiency and lower the cost of coal and ash handling.

Take advantage of this experience. Ask *first* for the recommendations of S-A engineers to assure yourself of maximum efficiency in handling equipment for your bulk materials. There's no obligation, so write today.

INTERSTATE POWER CO.
LANSING, IOWA

Swivel-mounted grab-bucket crane unloads coal from barges on either side of unloading pier. At transfer point, coal can be loaded on rail cars or dumped in track hopper from which reciprocating feeder supplies a 275 ft. long belt conveyor to junction house. There, coal is either chuted to outdoor storage or fed to inclined belt to top of boiler house. Horizontal belt conveyor runs over bunkers and belt tripper discharges coal to bunkers. Tractor drawn carry-all spreads coal over entire outdoor storage area and reclaims it to track hopper. System handles coal at 100 TPH.

STEPHEN S-A ADAMSON MFG. CO.

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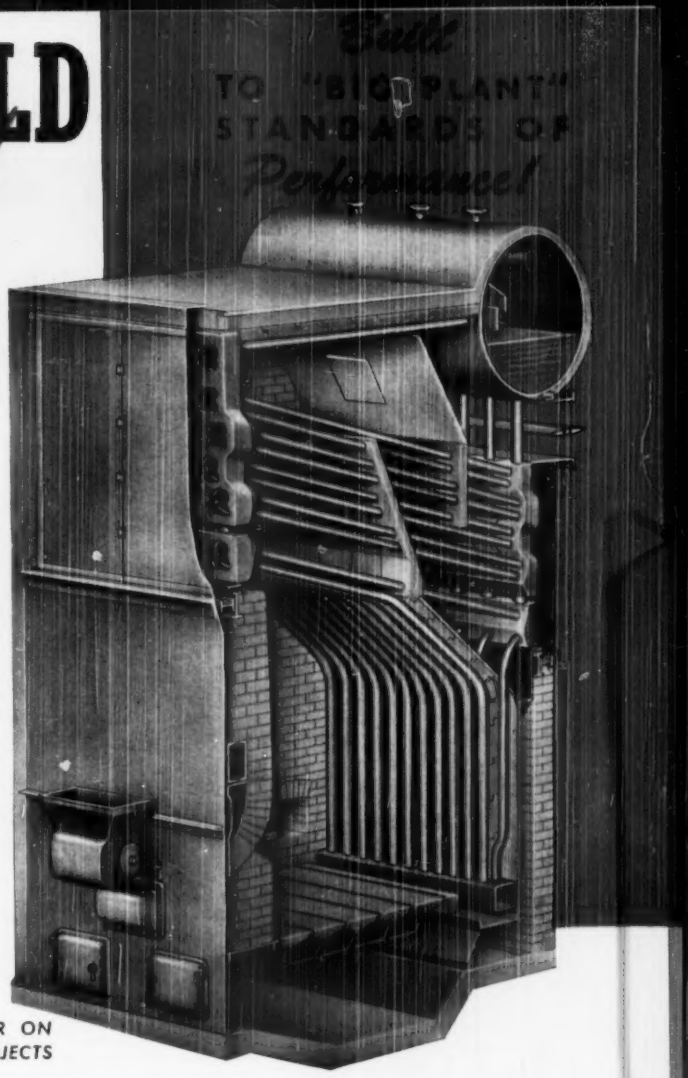
DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

SPRINGFIELD *Standardized*

TYPE MC COAL FIRED BOILERS



Choice of Sizes —Here is Springfield's new *Standardized* Type MC boiler. Available in a wide choice of sizes to help you meet small to medium size steam plant needs with minimum delay and less capital investment.

Standardized Construction — Boilers are assembled from same component parts. Height and depth are standardized. Width varies according to number of sections used.

Coal, Oil or Gas Firing — Designed for coal firing with standard stokers. Equally adaptable to high efficiency firing with standard oil or gas burners.

Quicker Delivery — Stocks of parts are maintained for prompt assembly and shipping of units. For information on delivery, see your local Springfield representative, or write.

CHECK WITH YOUR CONSULTING ENGINEER ON YOUR MODERNIZATION AND NEW PLANT PROJECTS

SPRINGFIELD PRODUCTS

BENT TUBE STEAM GENERATORS—Modern designs for capacities from 10,000 lbs. up.

STRAIGHT TUBE BOILERS—Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher.

STANDARDIZED TYPE M BOILERS—Standardized for quicker delivery and lower cost. Sizes 7,500 to 17,000 lbs. per hour.

WATER COOLED FURNACES—Heavy duty water walls. Exclusive center water wall construction for larger units.

SUPERHEATERS — AIR HEATERS — ECONOMIZERS—Individually designed to meet requirements.

BOILER No.	510	610	710	810	712	812	912	1012
Steam Capacity, Lbs. per Hr., continuous	7,500	9,000	10,500	12,000	12,500	14,300	16,000	17,800
Heating Surface, Sq. Ft.	895	1,077	1,256	1,430	1,490	1,703	1,918	2,128
Furnace Volume, Cu. Ft. Oil or Gas	305	360	415	475	550	625	700	775
Stoker	270	320	370	424	485	555	620	690
Furnace Width	4'7½"	5'6"	6'4½"	7'3"	6'4½"	7'3"	8'1½"	9'0"
Overall Width	8'2½"	9'1"	9'11½"	10'10"	9'11½"	10'10"	11'8½"	12'7"
Overall Length	11'11¼"	11'11¼"	11'11¼"	11'11¼"	13'10¼"	13'10¼"	13'10¼"	13'10¼"
Overall Height	19'4"	19'4"	19'4"	19'4"	19'4"	19'4"	19'4"	19'4"
Furnace Depth	7'10"	7'10"	7'10"	7'10"	9'7"	9'7"	9'7"	9'7"
Steam Outlet Size	4"	6"	6"	6"	6"	6"	6"	6"
Feed Inlet Size	1½"	1½"	2"	2"	2"	2"	2"	2"
Blow Off Size	2"	2"	2"	2"	2"	2"	2"	2"

SPRINGFIELD BOILER CO.

1953 E. Capitol Avenue Springfield, Illinois

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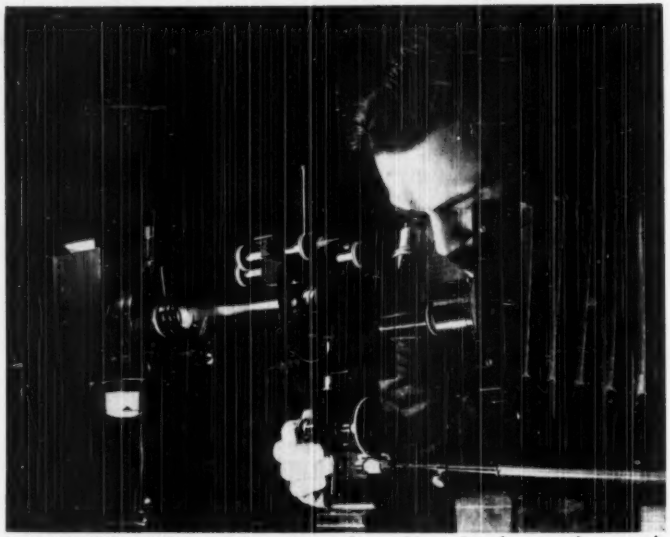


Behind BS&B's ability to deliver the goods on this rush order was the groundwork laid by a trained metallurgist.

It was late in the afternoon. BS&B Sales Engineer John Raidl was sitting at his desk, studying the SAFETY HEAD problem for a new chemical plant scheduled for construction. The telephone rang. Bayonne, New Jersey calling. An anxious voice, "Our new refinery is all ready to go. Except for one thing—we've got to have some special diaphragms for our SAFETY HEADS. The price isn't important. That plant must start operating the day after tomorrow! Can you send them by plane to arrive tomorrow night?"

Raidl jotted down the order. Two types of diaphragms were needed—three sizes — four different bursting pressures—lead lining or dipping on each diaphragm — all with vacuum supports tailored to fit. It was a tough order but he accepted it and immediately got in touch with R. S. Coffman, manager of the Diaphragm Department. He read him the order. "Great balls of fire!" roared Coffman, "They didn't miss a thing on that order, did they?" And they hadn't. "I can't do anything today — all the men have gone home—but we'll get rolling in the morning and you can consider the job done."

At five o'clock the next morning a workman lit the lead pots and the job was on its way. Two experts on material selection called "finders" got out their slide rules, made some rapid calculations, and selected four rolls of material from a stock that included the largest selection of thin ductile metals that is assembled in one place in the world. Allowance had to be made for the increase in bursting pressure that would result from lead lining and dipping. Samples were taken from each roll and inspected carefully for possible flaws. Two samples were dipped in the hot lead and the other two lined with thin lead sheet. Test diaphragms were made and burst to verify the bursting pressure estimated by the "finders." They were right on the money. Every sample proved out. Years of experience had given these men the know-how that could be obtained in no other way. A metallurgist from Quality Controls checked the materials to make sure they would do the job for which they were intended.

The green light was given to the fabricators. They cut material for the complete order, allowing for several extra diaphragms in each lot. On machines that were specially designed by BS&B, the diaphragms were formed and trimmed. Each one was put between flanges and tested up to 70% of its bursting pressure. They were checked for weak spots in the metal. None were found.

The inspectors took over. They checked each diaphragm carefully. Two from each lot were burst. Every one burst within 5% of the pressure at which it was rated. One of the inspectors found a thin scratch on one of the lead-lined aluminum diaphragms and scrapped it. You can't take chances in this business. People's lives and millions of dollars worth of equipment are at stake. Three new diaphragms were made. Two were burst. The bursting pressure checked out.

It was almost noon and the vacuum supports still had to be made. Another call from Bayonne, New Jersey. "Will that order be here tonight?" Work on the vacuum supports began. Each one had to be hand-tailored to fit the diaphragm with which it would be installed. A vacuum support chart that had been prepared from years of experience was consulted and the thickness and type of metal selected. Vacuum supports and diaphragms had to fit perfectly. There could be no air space between them. Fabricators worked carefully and skillfully. The job was finally completed and each diaphragm and vacuum support given a final inspection. Every item was approved and tabbed.

The job was rushed to the shipping department where the shipping manifest had been waiting since early morning. Each diaphragm and vacuum support was carefully packed to prevent possible scratching or denting. At 4:05 p.m. a special truck picked up the coveted package and whisked off to the airport eight miles away.

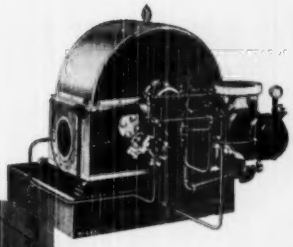
Threading his way through the heavy afternoon traffic, the driver finally screeched to a halt at the airport just as the plane taxied out to be loaded. He picked up his precious cargo, dashed into the airport office, and handed it over with the shipping manifests to a waiting clerk. As the plane roared down the runway for the takeoff with the package aboard, the driver stepped over to the telegraph office and wired the flight number to Bayonne, New Jersey.

That night an anxious group of engineers met the plane at the airport. They picked up the package and rushed off to their new refinery. A quick but careful installation of the SAFETY HEADS was made. The pipe line opened up. A new refinery was in operation. BS&B had come through!

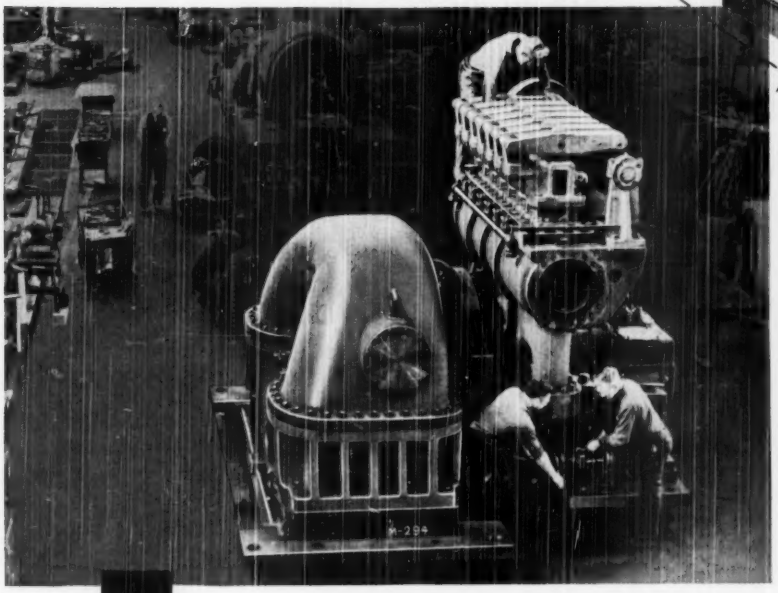
All orders for SAFETY HEADS are not filled as dramatically as this but they all get the same careful attention. If you have a pressure vessel protection problem in your plant, SAFETY HEADS may be your answer. Write today for complete details! Black, Sivalls & Bryson, Inc., Section SH-6, Special Products Division, Power and Light Bldg., Kansas City, Missouri.

(Advertisement)

Compact, sturdy, dependable. A Worthington single-stage, centrifugal compressor-drive turbine.



FROM SMALLEST SINGLE-STAGE



TO MULTI-STAGE GIANTS

A standout for size. One of two Worthington 24,000 hp centrifugal compressor-drive turbines during assembly.

Worthington Turbines Meet the Broadest Range of Drive Requirements

Worthington Turbines offer you unlimited choice of sizes and types — including straight condensing, straight non-condensing, extraction, mixed pressure extraction, low pressure and high back pressure. Steam or gas driven, for mechanical or generator drive, all are available with governors for constant or variable speed, with optional governor-control.

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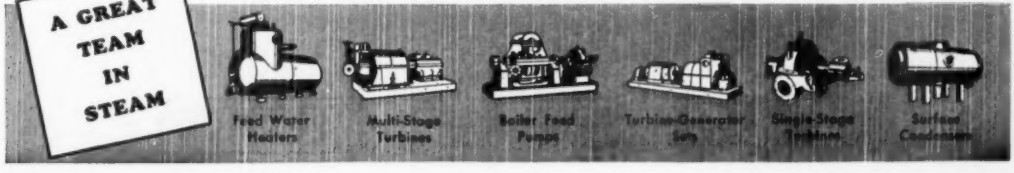
T9-3



In power or process piping, you'll

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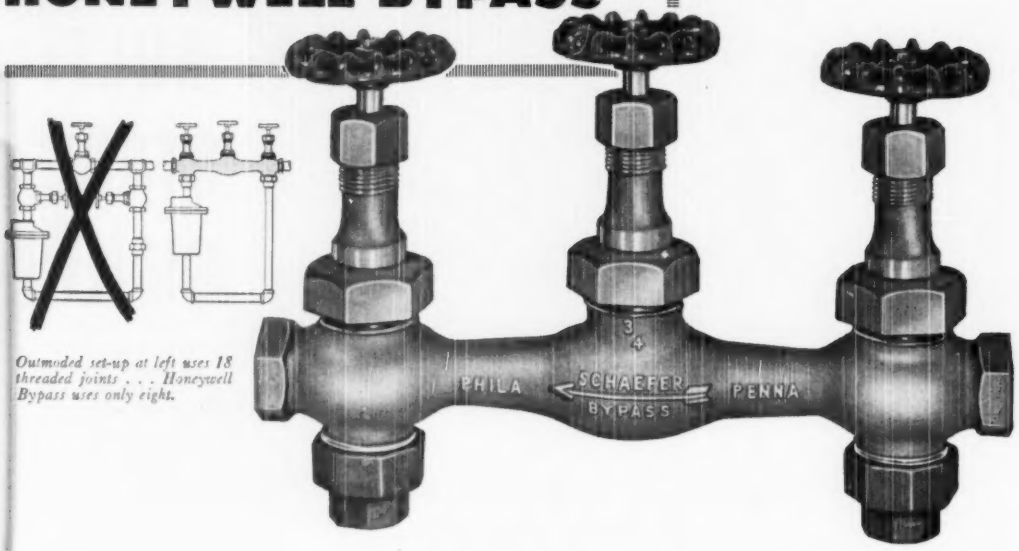
HONEYWELL BYPASS



Outmoded set-up at left uses 18 threaded joints . . . Honeywell Bypass uses only eight.

THE Honeywell Bypass is a completely assembled and ready-to-use unit . . . compact and convenient. It eliminates from eight to fourteen threaded joints . . . with the usual leakage and maintenance . . . and affords continuous, trouble-free operation.

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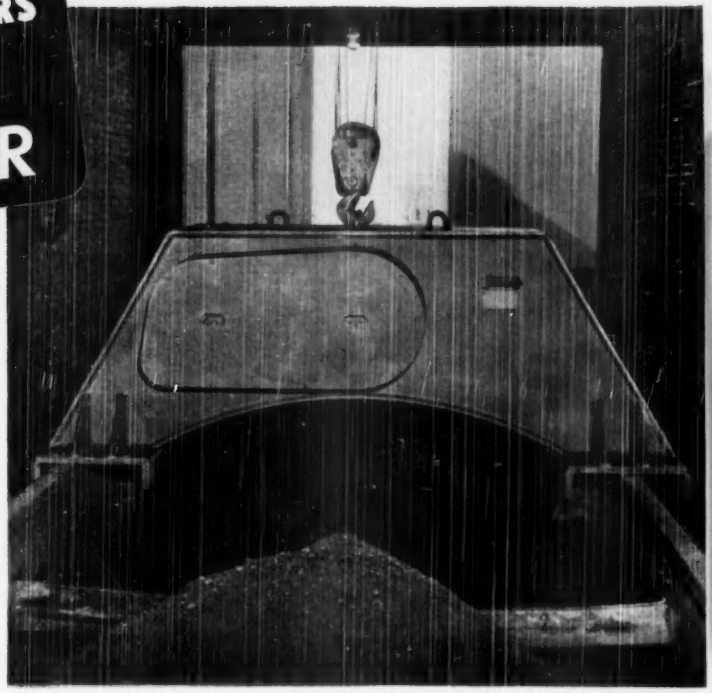

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CONSECO

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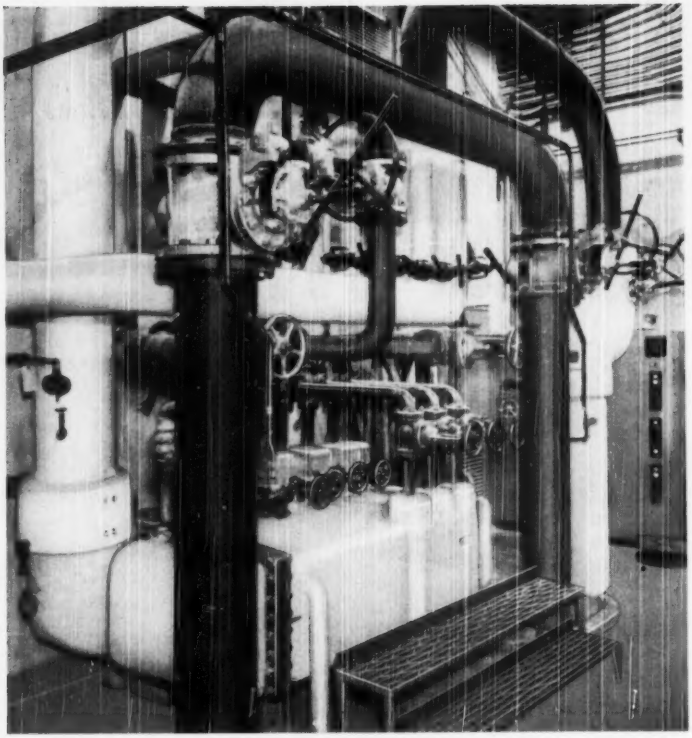
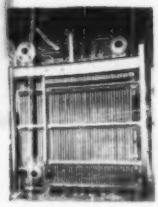


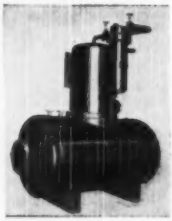
These Conseco Air Ejectors constitute part of units No. 3, 4 and 5 which are installed in the Harbor Steam Plant, Los Angeles, California. Each ejector operates with steam at 400 psig, 850° FTT and serves a twin 70,000 sq. ft. Conseco Condenser handling a 75,000 K.W. turbine.

CONSECO service is available for designing, manufacturing and installing Steam Jet Air Ejectors for all requirements of the power, chemical and process industries. Write for a copy of our new Engineering Bulletin #103, describing CONSECO EJECTORS in detail and giving valuable technical information.

Other Equipment in the* CONSECO *line



BOILERS



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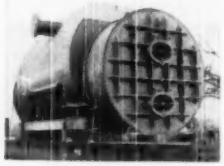

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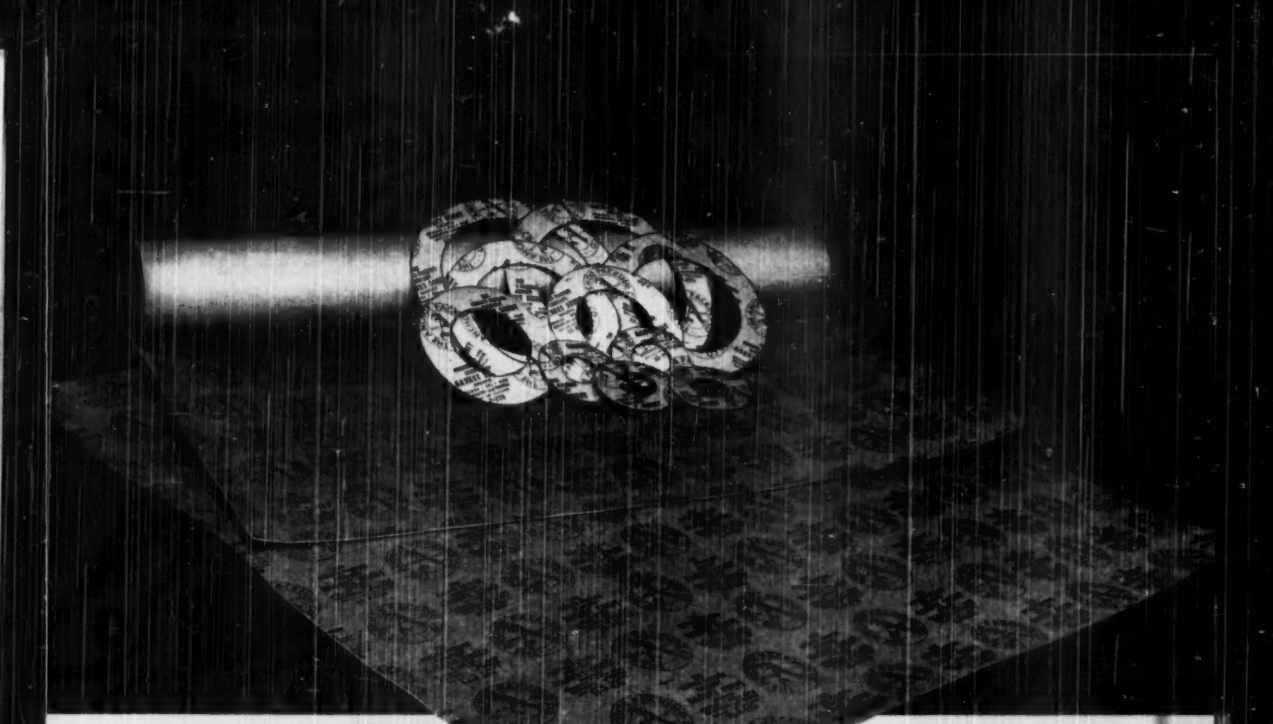

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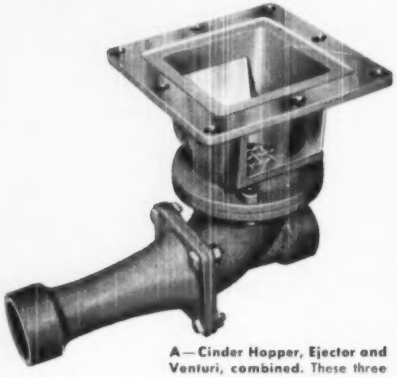
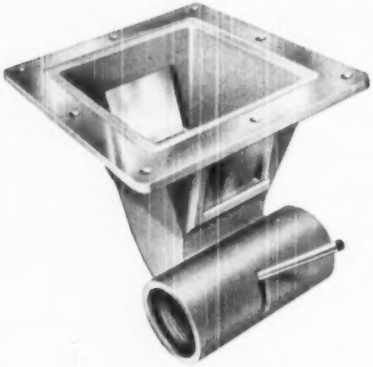
Now, for the first time, component parts from the Æ Cinder Reinjection System and the Æ Overfire Air System are available separately to help you handle siftings, fly ash, or overfire air no matter what type equipment you have. These parts, by ÆCo, designers of the famous Taylor Stoker and the Æ Perfect Spread Stoker, are meticulously engineered to perform their various functions. Contact your nearest ÆCo office or representative at once for full information and prices.

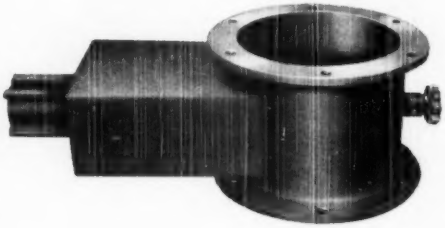


A—Cinder Hopper, Ejector and Venturi, combined. These three parts, normally the basis of the Æ Cinder Reinjection System, can now be obtained for use in systems of your own design. For continuous operation with steam or air.

B—Nozzle. Designed to introduce siftings into furnace properly. Flared to reduce entrance velocity. Oval port to slip between water walls if necessary. Fits over same diameter pipe as venturi. Uses steam or air.



C—Rotary Valve Hopper. Provides a convenient connection between sheet metal hoppers and piping. Simple rotary valve permits use of the hoppers in series. Operation may be quickly checked through Pyrex observation windows. Used when removal is intermittent.



D—Overfire Air Nozzle. A venturi-type unit developed for most effective use of entering air in controlling smoke. Nozzle has a built-in adjustable valve with a locking screw. For use with air only.

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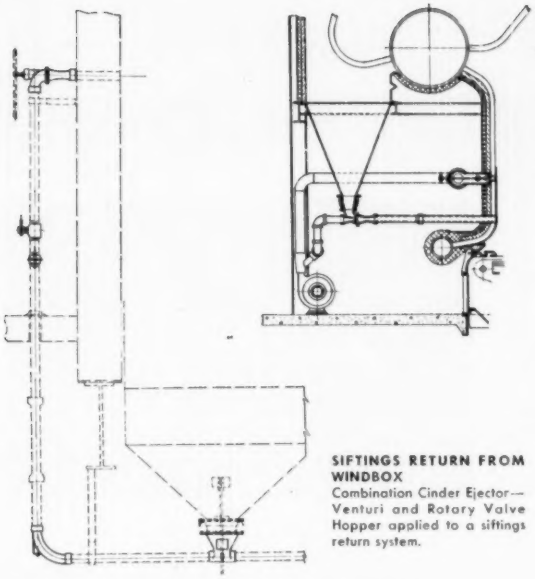
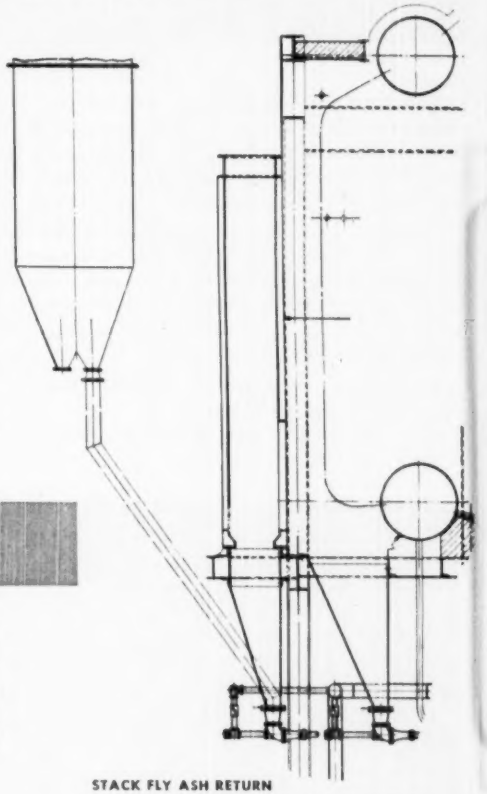
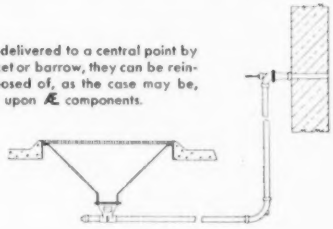


SIFTINGS RETURN FROM WINDBOX
Combination Cinder Ejector—Venturi and Rotary Valve Hopper applied to a siftings return system.

COMBINATION CINDER RETURN AND OVERFIRE AIR SYSTEM
Nearly all components shown in the left hand page are employed in this system for introducing overfire air and returning cinders from the last pass of the boiler. Overfire air and cinder return may be operated from same fan.



CENTRAL SYSTEM
Wherever fly ash or siftings are delivered to a central point by way of hoppers or even by bucket or barrow, they can be reintroduced to the furnace or disposed of, as the case may be, through a simple system based upon Æ components.



STACK FLY ASH RETURN
Typical arrangement, including Æ components, for returning fly ash from the stack to the furnace. Connections can be made to flues, economizers, or preheaters as well.

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For Best Results: Install CRYSTOLON Brick in Boiler Furnaces

The drawings and explanation below are based upon recent installations of Crystolon (Silicon Carbide) brick in boiler furnaces. Results have been completely satisfactory when the directions given here were followed.

Crystolon brick best demonstrate serviceability where there is need of uninterrupted peak operation. Produced at high temperatures these brick are particularly resistant to extreme heat. Their hardness makes them resistant to the abrasive action of ash and the motion of the fire bed.

The surfaces of Crystolon brick are sufficiently dense to prevent molten ash from taking hold by penetration and this same density enables them to resist the erosive action of slag.

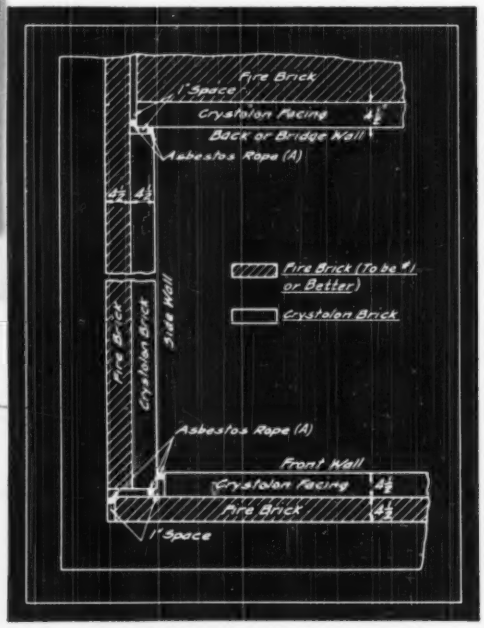

FIG. 1 *Typical Setting Showing Expansion Joints (A)*

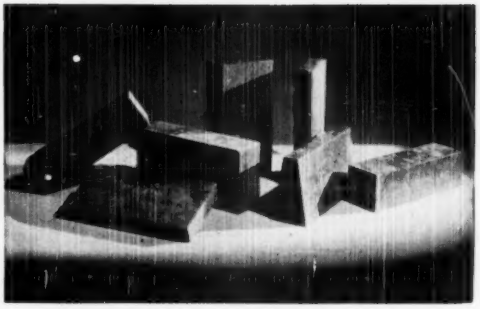

FIG. 2 *Crystolon Brick for Boiler Furnaces*

Other types of refractory brick often necessitate shutdowns or down-time to remove the clinker. While the clinker may sometimes adhere to Crystolon brick to a limited extent, these brick are sufficiently rugged to withstand the rather rough barring action that is commonly used to knock off the clinker.

Super refractory brick although costlier than ordinary fire brick actually give more economical service through reduced maintenance time and longer life.

It is advisable to use the same construction in the bridge wall as is shown (Fig. 1) for the side wall when Crystolon brick are used.

In cases where it may not be convenient to put in expansion joints as shown (see A, Fig. 1), expan-

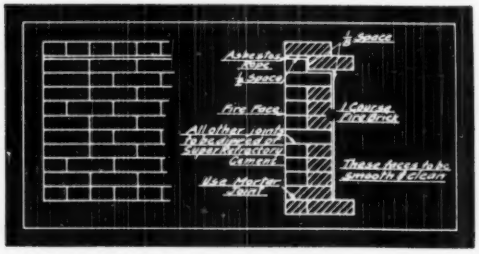
½ Space
Asbestos Rope
½ Space
Fire Face
1 Course Fire Brick
All other joints to be dipped in Super Refractory Cement
These Areas to be Smooth & Clean
Use Mortar Joint

FIG. 3 *Construction Using from 9 Courses up to 4' of Crystolon Brick*

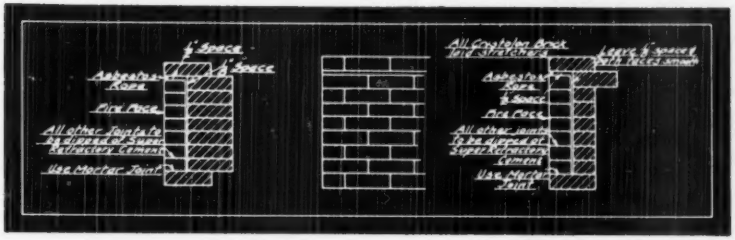

FIG. 4 *New Construction (left) and Repairing Old Construction (right) Where 7 Courses or Less Are Used*

sion can be taken care of by leaving $\frac{1}{16}$" to $\frac{1}{8}$" open joint between each brick in the stretcher courses or every second brick in a header course. In any case, expansion allowances must be made. A good rule to use is approximately $\frac{1}{8}$" expansion to 15" of Crystolon brick in the wall.

For best results, not less than five courses of Crystolon brick should be used in any boiler furnace except in cases where exceptionally thin fire beds are carried and peculiar conditions of operation might justify the use of fewer courses.

In general, five to nine courses are used depending on the type of stoker, size of furnace, thickness of fuel bed carried and rating at which boiler is to be operated. If too few courses are used, there is danger of a slag curtain building down from the fire brick above and interfering with the efficiency of the Crystolon brick.

Always use a super refractory cement* for laying up the Crystolon brick. A dipped joint is best in laying Crystolon brick, unless otherwise specified. The brick should be hammered down tightly to make as nearly a face-to-face joint as possible. *Do not use ordinary fire clay or fire brick cements nor any of the groups known as air-setting or air-hardening cements in contact with the Crystolon brick.*

*Send for Norton Refractory catalogs: Cement No. 863-Crystolon Brick No. 862.

In the center retort, side-dump type of stoker the Crystolon brick should be started 3" below the nose of the dump plate.

In the multiple retort type of underfeed stoker the Crystolon brick should start at the grate line and follow the slope of the stoker, using a few more courses of Crystolon brick in the side wall toward the rear of the stoker. It is well to use standard jamb or bull nose and arch brick to build around the rear inspection door.

In the chain grate type of stoker the Crystolon brick should be laid directly on the side wall bed plate or in any case should start slightly below the top of the chain grate. In the case of one type of Cox stoker now in use a special Crystolon brick is employed with a $\frac{1}{2}$" cut-out which fits directly over the side wall plate.

In hand-fired boiler furnaces it is common practice to start the Crystolon brick an inch or two above the top of the grate.

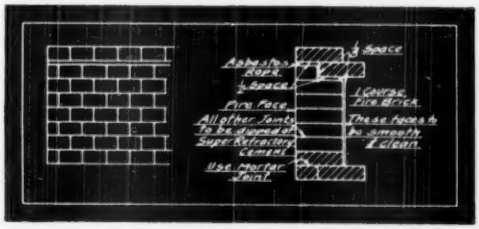
½ Space
Asbestos Rope
½ Space
Fire Face
All other Joints to be dipped in Super Refractory Cement
Use Mortar Joint
1 Course Fire Brick
These faces to be smooth & clean

FIG. 5 *Construction Using 9" Crystolon Wall All Headers up to 4' in Height*

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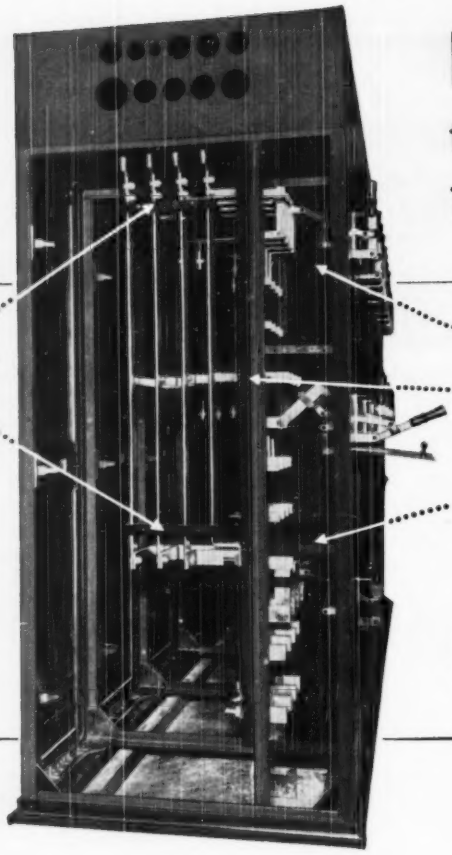

In addition to bus supports and mounting panels of K&M Ebonized Asbestos, this Pringle Switchboard has separators of K&M Monobestos—another versatile K&M material that betters electrical equipment.

High dielectric strength, high physical strength and high adaptability, all count in placing Ebonized Asbestos in much of the precise electrical equipment. Precision manufacture under high pressure, using specially developed raw materials, provides a product that can be readily machined, cut and drilled.

Pringle Electrical Manufacturing Company, Philadelphia, applies K&M Ebonized Asbestos to bus supports and mounting panels of the Dead Front Safety Knife Switch illustrated. The electrical safety factor is inherently high per unit of material. So is the mechanical safety factor, because there is strength in all directions with K&M Ebonized Asbestos. It particularly resists shock, vibration and temperature fluctuation.

These characteristics are valued by designers and engineers, for switchboard mountings, bus bar runs, compartment linings, test tables, bench boards and related applications. With K&M Ebonized Asbestos available in thicknesses from 1/8" to 4", any requirements can easily be met. For additional details write us; we'll answer you promptly.

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FANMIX can easily be operated with your present furnace and stack, requiring only minor changes in other equipment. Or if you're planning on new boilers, remember that **FANMIX** relieves the furnace from the burden of mixing, creates its own forced draft and takes smaller pipe sizes. Which means you can plan on reduced combustion space, less stack, no forced draft equipment and lower installation costs all around.

Get the Whole Story

Coppus engineers FANMIX Burners to meet individual requirements, providing complete control over heat pattern and combustion . . . Learn more about how "pinwheel action" can step up *your* boiler performance to peak efficiency and economy — as it is doing throughout industry. Send for Bulletin 410-6. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, and MINING CATALOGS.

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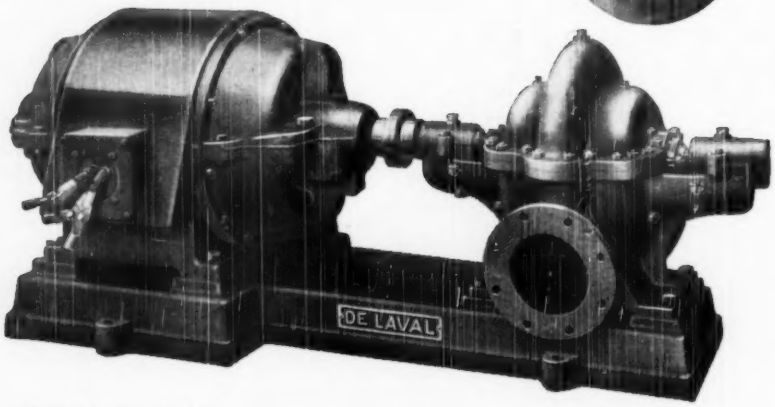

Here's the reason why

Assume that two pumps attain the same efficiency when new. One is equipped with ordinary close clearance, flat rings at the running joint between impeller and casing; the other with large clearance labyrinth rings.

As wear increases the clearance between the rings, the efficiency of the pump equipped with flat rings drops off more rapidly than that of the labyrinth ring pump because the flow retarding action of the flat rings depends solely upon the maintenance of close clearances; while the flow retarding action of the labyrinth rings is due to the resistance of a labyrinth passage.

The longer the pumps are used, the greater the difference in leakage, the greater the difference in efficiency and the greater the saving due to the use of De Laval labyrinth wearing rings. Every year the power savings grow greater.

When selecting a pump consult the rating tables in De Laval Catalog 10-15-P.

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CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

10-15

POWER

CROSS-INDEX OF SUBJECTS FOR THE MONTH

JANUARY 1950 • VOL 94 • NO. 1

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PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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Cover photo, courtesy of Nordstrom Valve Div, Rockwell Mfg Co

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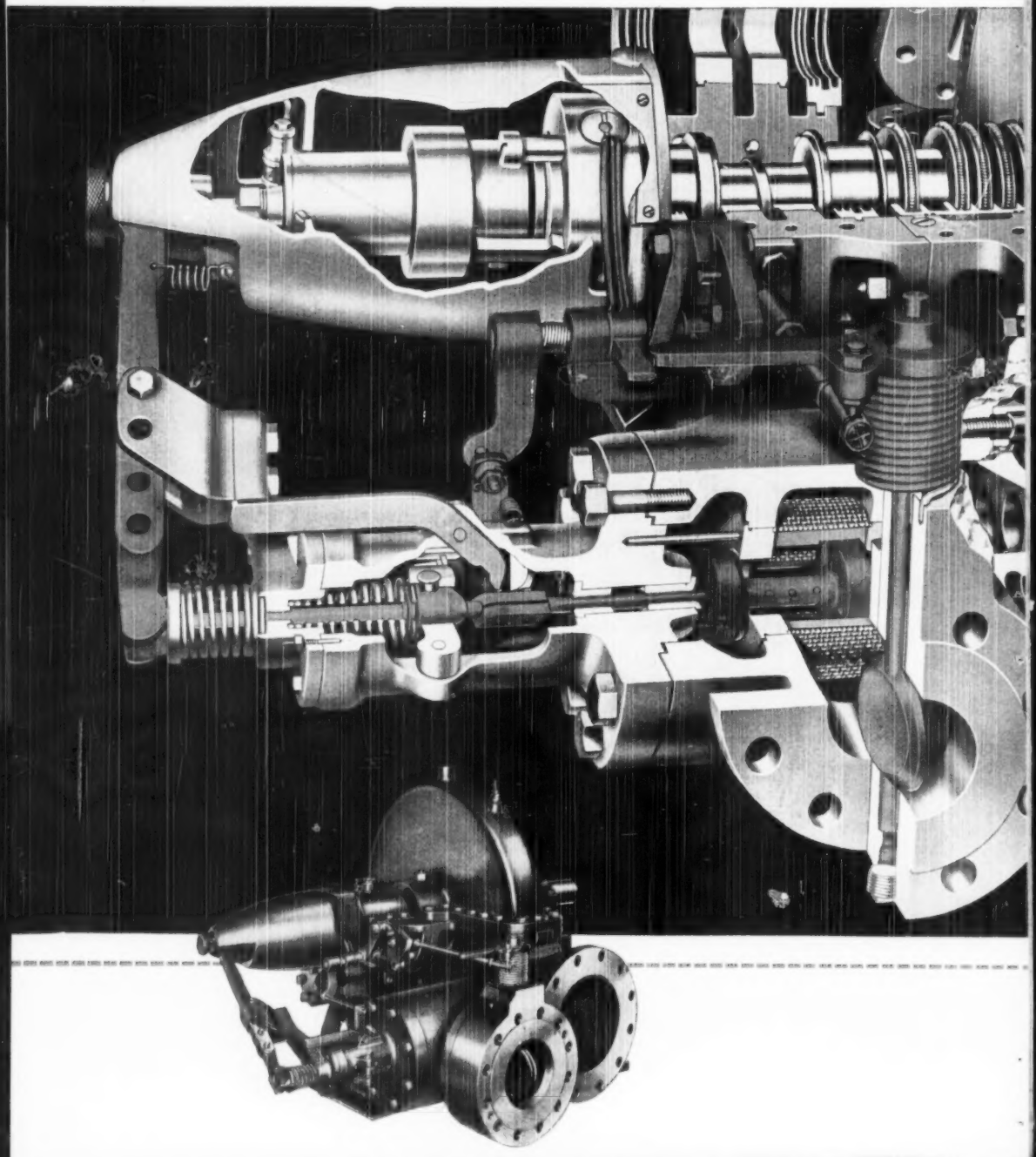
YOU CAN BE **SURE**.. IF IT'S

Westinghouse



It's DOUBLE safe!

With Type E turbines, you can be sure of protection against overspeed. You can be doubly sure.

A sensitive, powerful centrifugal-weight governor provides extremely accurate speed control. Both the governor and its linkage connection are enclosed in a strong, specially-shaped housing to protect them from damage.

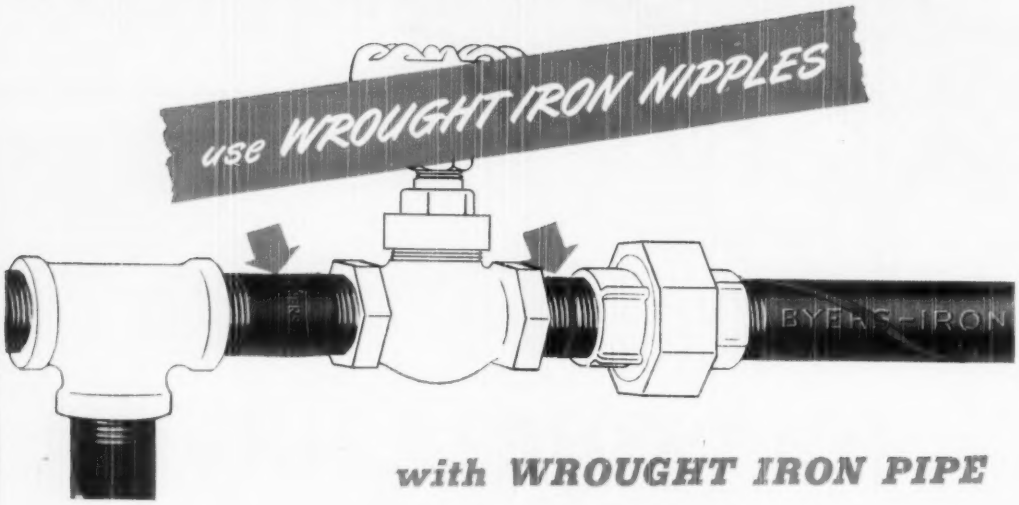
However, if for any reason the governor loses control, Type E *dual* protection takes over. A corrosion-resistant, spring-restrained weight, mounted in the governor hub, strikes a trip linkage . . . instantly closes the governor valve and an independent steam inlet butterfly valve. Steam is cut off positively . . . danger and resulting damage of overspeed are avoided.

Dual protection is but one of the significant features of Type E turbines. Wrapped up in one standard unit are the best features of previous Westinghouse mechanical drives, plus important refinements and new developments that add up to economical, dependable service under all operating conditions.

We invite your comparison . . . on *any* count. Get the facts from your nearby Westinghouse office, or write for 20-page book B-3896. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50491

Westinghouse TYPE E Turbines

Avoid "Weak Links" in your piping systems—



with WROUGHT IRON PIPE

When you specify wrought iron pipe to lick some corrosion problem, assure 100% protection by specifying that the pipe nipples also must be wrought iron. Neglect of this simple precaution will leave weak spots in your lines, and set the stage for maintenance headaches.

METHOD OF SPECIFICATION

Merely stating that the piping "system" is to be black or galvanized wrought iron is not enough; the use of wrought iron nipples should be specifically designated. This may be done by requiring that the wrought iron nipples shall be made of pipe conforming to the requirements of A.S.T.M. Specification A72-45, Federal Specification WW-P-441a, Navy Specification 44P11k, or any accredited proprietary specification.

WIDE RANGE OF SIZES

Byers Wrought Iron nipples, both standard weight and extra strong, are available in a wide range of sizes and lengths, either black or galvanized. They are manufactured from new, tested, full-weight wrought iron pipe in accordance with the standards established in the specifications of leading technical organizations. All nipples are furnished with right-hand threads unless otherwise specified; nipples with right and left-hand threads are also available. Nipples are furnished "close" or to length as specified.

IDENTIFICATION

The word "Byers" and the weight —either "Std." or "X Stg." are machine stamped around the circumference of Byers Wrought Iron nipples. On close nipples, where it is impractical to stamp on the threads, a red band is used. These markings provide quick, positive identification of Byers Wrought Iron nipples, and help to avoid any danger of accidental substitution of non-durable nipples in the line.

IN WELDED SYSTEMS USE WROUGHT IRON WELDING FITTINGS

Wrought iron welding fittings are available in a wide range of types and sizes from leading fitting manufacturers. Just contact your supplier.

Wrought iron nipples are also available from a number of manufacturers. The identification used on such nipples may be learned by consulting the supplier.

INHERENT CORROSION RESISTANCE

The superior resistance of wrought iron nipples comes from the unique composition and structure of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and "detour" corrosive attack, and so discourage pitting. The fibers also anchor the initial protective scale, which shields the underlying metal.

The best guide in applying wrought iron is a knowledge of its character and properties. The complete story is presented in the booklet, "The ABC's of Wrought Iron". Ask for a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco. Export Division: New York, N.Y.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • JANUARY 1950 • ESTABLISHED IN 1882

Let's Look Ahead

WHAT'S AHEAD in power equipment? We can't know for sure, but let's stand at the middle of this twentieth century and look ahead ten, twenty, even fifty years, through the eyes of Westinghouse division heads. Ten of these top-flight engineers have dared to set down in black and white what may reasonably be expected. The occasion was the recent Mid-Century Review and Forecast Forum in East Pittsburgh.

Central-station turbines, says Morgan, vice-president, South Philadelphia turbine works, will get bigger as fast as system growth calls for larger sizes. And he thinks the day may come, but not soon, when throttle steam at 1200 F and critical pressure of 3200 psi will produce 300,000 kw in a single compound unit.

As for the generator end, don't worry, says Laffoon, manager, ac-generator engineering department. The generators will keep pace—be as powerful as needed to match the turbines and built to deliver from a third to a half more power per pound of metal. That means savings in investment cost and operating labor.

Turning to motors, Ludwig, general manager, Buffalo motor division, explodes the notion that the dc motor is slipping. It's just the other way, he says. Despite the convenience and simplicity of ac generation and transmission, the dc motor is finding two new uses for every one it loses in this age of controlled speed.

Here's another trend: Ludwig foresees more totally enclosed motors with windings protected by the new heat-resistant silicones and similar insulations. He also figures that these totally enclosed motors will approach a standard form that can replace many of today's specialized motors for a great variety of hard-service applications.

To read more about future turbines, generators and motors, turn to page 102 of this issue. For all ten papers complete, consult the January number of the *Westinghouse Engineer*.

Now for a few thoughts of our own about this matter of the power-equipment future.

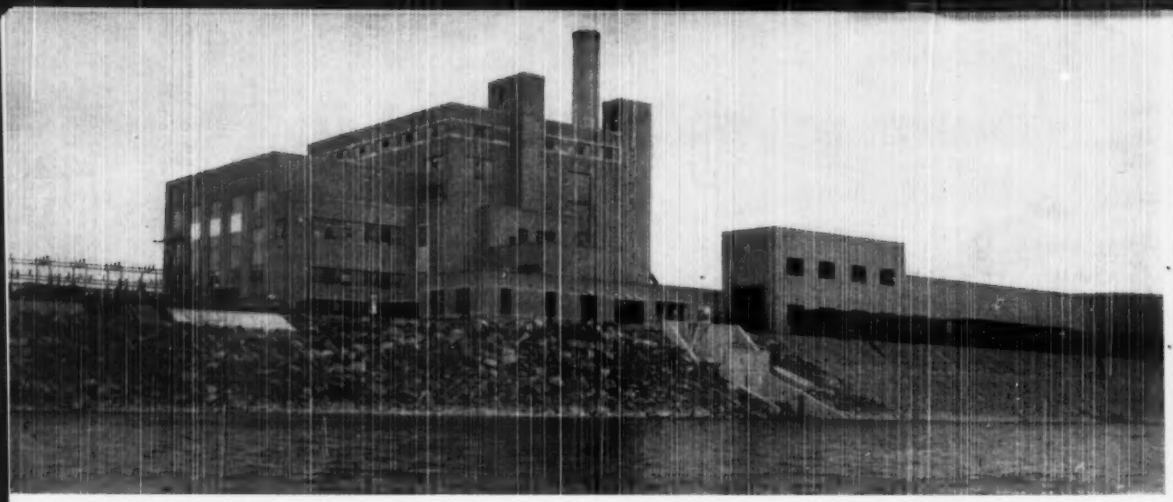
First, coal consumption is already under 0.8 lb per kwhr, so any further gains must be sweated out a few hundredths at a time. The possible additional saving is worth working for, but it can't be revolutionary. The same holds for the possible savings in first cost and operating labor through bigger turbine-generators.

As we see it, the biggest economic revolution will be not in much cheaper power, but in far wider use of power, even now so cheap that its total delivered cost is but a tiny fraction of the national income it generates.

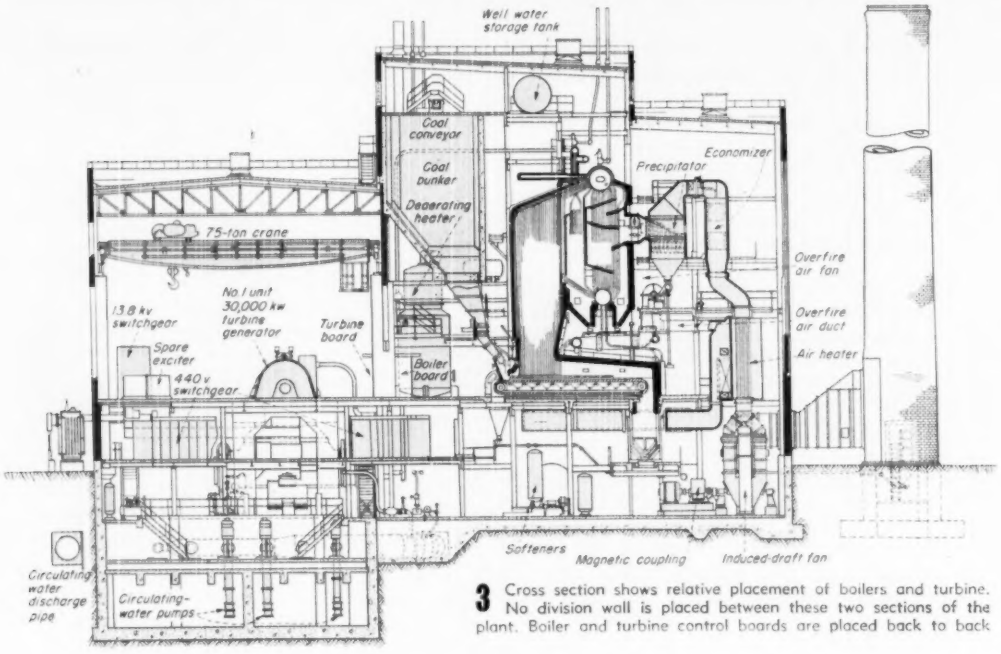
Next, we look for big economic gains through the more perfect application and control of power at the working end.

Finally we see, as the sure result of increased productive efficiency, that a man-hour of maintenance labor will cost a bigger and bigger fraction of the price of a motor. The moral is that management will be willing to pay more for motor quality to cut maintenance labor.

So we have a strong hunch that the new silicones, and other fancy heat-resistant insulations, will be used not so much to make ultra-compact hot-running motors, as to give us fairly expensive units that will run a lifetime with little or no trouble.



1 Hickling Station, on the Chemung River near Corning, N. Y., has one unit at present. Low structure at right is the car-thawing shed, an extension to the track-hopper house. Structure at river bank leads to cooling-water inlet and exit



3 Cross section shows relative placement of boilers and turbine. No division wall is placed between these two sections of the plant. Boiler and turbine control boards are placed back to back

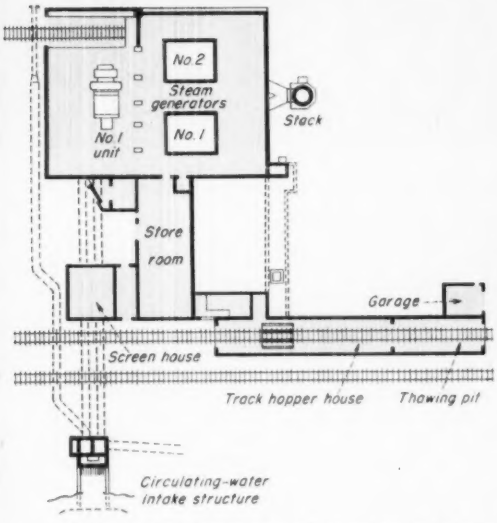
Hickling Station Completes Its First

► SEVEN MILES east of Corning, N. Y., on the Chemung River, stands the Hickling Station, dedicated to the memory of William G Hickling, former vice-president and general manager of the New York State Electric and Gas Corp. While largely duplicating the Jennison Station at Bainbridge, N. Y. it has a number of improvements that make it the lowest-cost generating unit in the system.

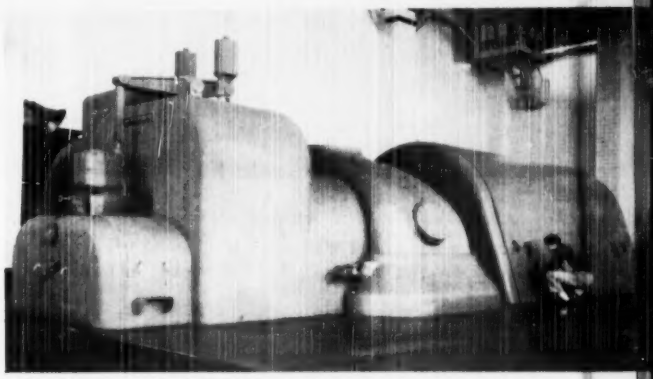
Load growth required this additional capacity in the Elmira-Corning area. Formerly the supply depended on relatively long transmission lines from Greenidge Station about 40 miles north, backed up by the peak-load Riverside Station in Elmira.

Flash floods here require special precautions in picking plant sites. The spring of 1946 produced the worst

2 Two 175,000-lb-per-hr boilers supplying 30,000-kw unit burn No. 4 buckwheat-anthracite coal on traveling-grate stokers. These 24x28-ft stokers carry a normal fuel-bed depth of 3½ in., are fed by nine air compartments underneath



4 Future extensions to plant will be made at top of plan view. Coal-storage yard, to right of main building and above track-hopper house, minimizes coal handling



5 Preferred standard 30,000-kw turbine-generator uses only four of its five bleed points in station heat-balance cycle, Fig. 10

Rising anthracite prices lead to choosing higher throttle steam pressure and temperature. Large traveling-grate stokers burn No. 4 buckwheat at 3.5-in. coal depth with 84% boiler efficiency

Year of Service

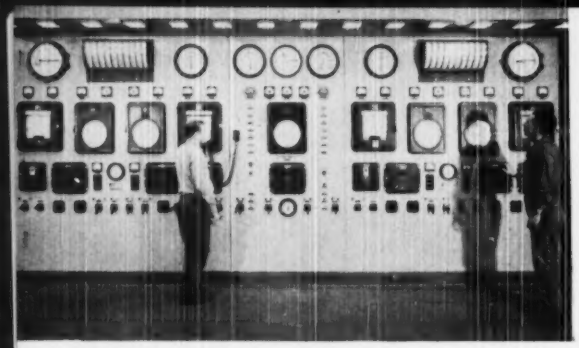
By W GREACEN 3rd
Mechanical Engineer, New York State Electric & Gas Corp

floods this area has known. The Hickling Station, however, is protected to 3 ft above the highest flood elevation.

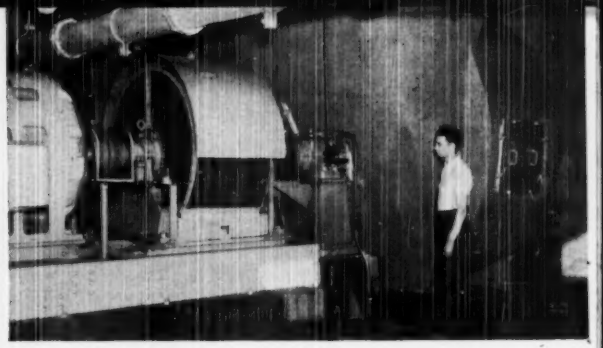
The first 30,000-kw unit, of an ultimate 60,000- or 100,000-kw plant capacity, began commercial operation on December 22, 1948. This addition has contributed to more than doubling system capacity in the last seven years.

Like Jennison, Hickling was designed to burn No. 4 buckwheat on traveling-grate stokers. Operating pressure and temperature were raised to 850-psig and 900 F, compared to Jennison's 650-psig 825-F, to compensate for rising price of anthracite.

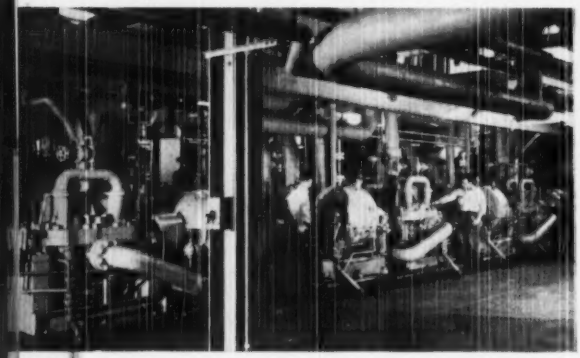
Steam Generators. Two 175,000-lb-per-hr steam generators of conventional 2-drum design have a furnace arrangement adapted to traveling-grate stoker firing. Experience at Jennison led to



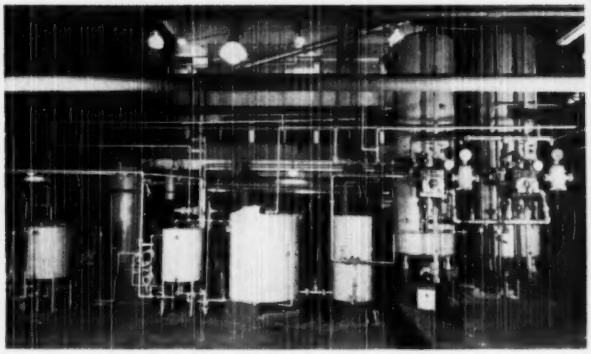
6 Combustion control board for two boilers faces traveling-grate stoker fronts on operating floor, centralizes controls



7 Two 124,000-cfm induced-draft fans operate at variable speed through magnetic coupling to 720-rpm electric motors



8 Three 200,000-lb-per-hr boiler feed pumps have motor, turbine, and dual drives, respectively, from left to right



9 Ample room and accessibility aid in water-treating plant operation. Makeup drawn from one shallow, one deep well

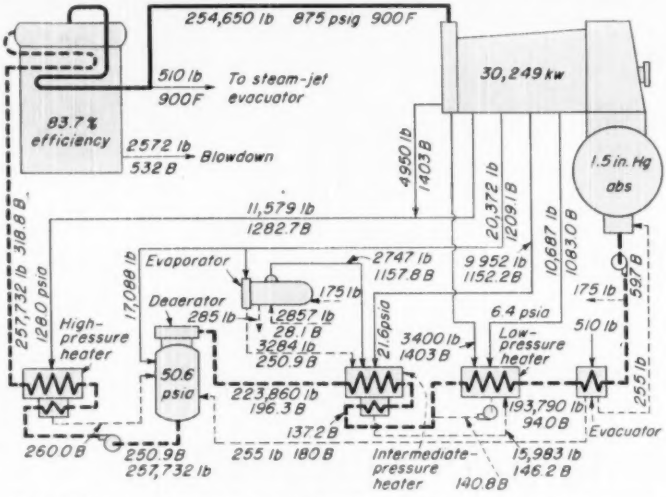
(1) minimizing tube erosion by shielding vulnerable areas (2) returning unburned cinders through the furnace arch on to the active fuel bed for reburning (3) returning stoker siftings for reburning.

The traveling grates, 24 ft wide by 28 ft long, carry a normal fuel-bed depth of 3½ in. Stoker speed varies from 0 to 90 ft per hr. Controlling input to the motor and reduction gear by varying resistance in an electronic circuit automatically adjusts stoker speed. Nine compartments for air distribution are manually controlled.

A combustion-control system automatically regulates boiler output in proportion to demand. Steam-pressure deviation changes (1) fuel input by varying stoker speed and (2) air supply by adjusting the induced-draft fan magnetic coupling. F-d fan vane position controls furnace draft. Automatic setting of bypass dampers controls steam temperature.

Precipitators ahead of economizer and air preheater minimize erosion problems. All material collected in the precipitator (60 to 70% carbon) returns through a cinder-return system to the furnace rear. Injected through heat-resisting durite nozzles, the cinders burn partly in suspension and partly on the grate where the heavier particles fall.

A continuous-loop economizer and tubular air heater complete the heat-exchange units in the steam generators. Air heater raises air temperature to 300 F. To date it has not been necessary to use the rotary and retractable soot-blower elements. Scrubbing action



10 Station heat-balance cycle uses four heaters; intermediate and high-pressure heaters have subcooling zones. In addition h-p heater has desuperheating zone

of the cinder-laden gas keeps the tube surface free of accumulations. A fine, powdery ash deposits on the air-heater tubes and must be hand lanced to maintain desired air temperature and efficiency.

Turbine-Generator. The preferred-standard 29-stage unit has one impulse and 28 reaction stages. Rated at 30,000 kw it uses 850-psig 900-F throttle steam and exhausts at 1.5 in. Hg abs. It drives a direct-connected 30,000-kw 85%-pf hydrogen-cooled generator at 3600 rpm.

Heat Balance. The cycle uses four stages of feedwater heating. Fig. 10. Steam bleeds from the turbine at the 14th, 19th, 22nd and 25th stages. Deaerating-heater pressure varies as the 19th-stage pressure. All feedwater heaters are the vertical type. Boiler feed pumps pass the condensate and makeup from the deaerating heater through the h-p feedwater heater on its way to the boiler. Recirculating lines on each feed pump automatically cut in at low loads. The evaporator supplied from the 19th-stage bleed point furnishes 1.5 to 2% makeup as vapor to the intermediate-pressure heater.

The three boiler feed pumps, one motor-driven, one turbine-driven and one dual-driven, were selected on an economy basis. Cost of purchased power during system peaks versus investment and operating costs for turbine drives justified their installation. Exhaust from the turbine drives discharges into the 19th-stage extraction line, decreasing the steam bled from the main turbine. This increases net station output by about 1200 kw.

Fuel and Ash Systems. The plant railroad siding has two tracks, accommodating a large number of cars. A plant locomotive shunts cars into the track-hopper house. During freezing weather cars are placed over thawing pits located in an extension to the track-hopper house, but segregated by an overhead rolling door. Power-driven ventilators provide air circulation. Opposed low-pressure oil burners fire the radiant-refractory-type thawing pits between the tracks.

After defrosting, the car is moved to the unloading hopper having a capacity of 70 tons. Space has been allowed for a car shakeout, but it will not be installed until the station is extended.

The conveying equipment, rated at 100 tons per hr, consists in sequence of four reciprocating feeders below the unloading hopper, inclined belt conveyor, belt bucket elevator, second inclined belt conveyor and, finally, an enclosed screw conveyor distributing coal to the two bunkers. The reciprocating feeder speed varies to supply maximum tonnage to the balance of the conveying system. The first belt that receives coal from the feeders has a weightometer and reclaim chute where storage coal enters the system. At the head of the belt bucket elevator, coal may be diverted to storage or continued to bunkers via the second cross belt and 18-in. screw conveyor.

The two 350-ton bunkers are of reinforced-concrete design. They are straight sided, except the rear, which slopes at an angle of 50 deg starting two thirds down from the top. Anthracite tile lines the sloping section. Coal flows by gravity from the bunkers to the stoker hoppers through inclined carbon steel chutes lined with stainless steel.

Ashes discharge continuously from the stoker into a flooded water-sealed ashpit of steel-plate construction. Cast refractory lines the upper part of the ashpit, and paving brick the bottom part. Five high-pressure water jets remove ashes from the hopper. A hydraulically operated gate allows the ash to discharge onto a grid that breaks up clinkers. A hydraulic jet removes the ash-water mixture to a 3-acre settling basin. A local cinder-block manufacturer buys the entire ash output. He provides the reclaiming and loading equipment.

A vacuum system, which removes the ash and cinders from the base of stack and front stoker hoppers, completes the ash-handling equipment.

Cooling Water. During the dry season, stream flow past the plant site becomes lower than is considered desirable. More than ordinary attention was given the volume, duration and effect of low stream flow on plant operation. With future additions more circulating water may be needed than will be available from stream flow.

After a careful study of condenser economics and design it was agreed that, during a few days of the year with future units running, some recirculation would be necessary. The increased inlet temperature at such future time led to choosing a larger condenser than needed by present conditions. With these conclusions a surface type, 27,500-sq-ft 2-pass condenser with two separate tube bundles having separate water circuits was purchased. Condenser has 5830 tubes, ¾-in. OD, 24 ft long, of No. 18 BWG arsenical Admiralty. It maintains a backpressure of 1.5 in. Hg abs when condensing 230,000-lb-per-hr steam with 20,900-gpm cooling-water flow at 65 F.

A trash rack at the circulating-water intake removes all large foreign matter from the water. It then flows through either of two traveling screens in the screen house. Each screen has a wash pump operated by differential pressure control. This automatically starts the proper screen-washing pump when the water-pressure drop across the screen exceeds 2 in. of water.

(*Continued on page* 150)

PRINCIPAL POWER-PLANT EQUIPMENT

HICKLING STATION, NEW YORK STATE ELECTRIC & GAS CORP
CORNING, N. Y., UNIT NO. 1

STEAM GENERATORS:

Boilers, 2.....Combustion Engineering-Superheater, Inc
2-drum bent-tube. 13,240-sq-ft heating surface, 175,000-lb-per-hr continuous, 875 psig 910-F steam; 9550-cu-ft furnace volume, 5680-sq-ft gas-swept surface on superheater, 7670-sq-ft economizer surface, 12,000-sq-ft tubular air heater. Bypass-damper superheat control

Stokers, 2.....Combustion Engineering-Superheater, Inc
Traveling grate, 24 ft wide, 26 ft long, 672-sq-ft effective grate area; 0 to 90-ft-per-hr speeds. Burns No. 4 buckwheat, 3½-in. normal fuel-bed depth. Louis-Allis variable-speed-motor stoker drive with electronic control

Cinder-return systems, 2.....United Conveyor Corp
Cinders from two boiler hoppers and Western precipitator injected into furnace with air from cinder-return fan. Fan capacity, 2850 cfm at 80 F and 28-in.-water static pressure

Overfire-air-system fans, 2.....American Blower Corp
Overhung rotor, 9500 cfm at 300 F against 10-in.-water head, 40-hp motor drive

Soot blowers, 32 elements.....Diamond Power Specialty Corp
On each boiler: 14 revolving elements at 155 psig, 2 retractable elements at 125 psig

Dust collectors, multicyclone, 2.....Western Precipitation Corp

Induced-draft fans, 2.....American Blower Corp
124,000 cfm at 357 F, 14.6 in. water pressure, watercooled bearings, outlet damper

I-d fan magnetic coupling, 2, electronic control.....Dynamatic Corp

I-d fan drives, 2.....General Electric Co
450 hp, 720 rpm, 440 v, 3 phase, 60-cycle motor

Forced-draft fans, 2.....B F Sturtevant Div, Westinghouse Electric Corp
67,500 cfm at 100 F, 10-in. static pressure, vane control

PLANT EQUIPMENT *CONTINUED*

F-d fan drives, 2 ..... General Electric Co
150 hp, 1200 rpm, 440 v, 3 phase, 60 cycle, direct connected
Automatic combustion control ..... Leeds & Northrup Co
Flues and ducts ..... Connery Construction Co
Chimney ..... M W Kellogg Co
Radial brick, 142 ft high, 11-ft top diameter

TURBINE-GENERATOR AND AUXILIARIES:

Turbine-generator, 1 ..... Westinghouse Electric Corp
Preferred standard, 30,000 kw, 3600 rpm, 29 stages, 850-psig 900-F throttle steam. Four of five extraction points used. 35,294-kva 3-phase 60-cycle 13,800-v hydrogen-cooled generator
Main condenser ..... Ingersoll-Rand Co
27,500 sq ft, 5830 arsenical Admiralty tubes, 2-pass, two separate tube bundles with separate water circuits, 1.5-in. Hg abs with 230,000-lb-per-hr steam flow and 20,900 gpm of 65-F cooling water; 2-stage 2-element air ejector operating with 300-psig 860-F steam.
Circulating water pumps, 3 ..... Ingersoll-Rand Co
Vertical, single stage, mixed flow, 1160 rpm, 2 at 8760 gpm, 1 at 4380 gpm
Circulating-water pump drives, 3 ..... General Electric Co
Two 150 hp, 1160 rpm, 440 v, 3 phase, 60 cycle, vertical. One at 75 hp, 1170 rpm, 440 v, 3 phase, 60 cycle, vertical
Traveling water screens, 2 ..... Chain Belt Co
45,000 gpm, 8-ft wide baskets. Automatic control on head diff
Water-screen drives, 2 ..... Louis Allis Co
3-hp 208-v 3-phase 60-cycle 1150-rpm motors, speed reducer
Water-screen wash pump, 2 ..... Ingersoll-Rand Co
300 gpm at 250-ft head. 25-hp motor drive
Chlorination plant ..... Wallace & Tiernan Co

FEEDWATER EQUIPMENT:

Condensate pumps, 2 ..... Ingersoll-Rand Co
5-stage vertical, 500 gpm, 1750 rpm, mixed flow
Condensate-pump drive, 2 ..... General Electric Co
60 hp, 1750 rpm, 440 v, vertical, squirrel-cage motors
Boiler feed pumps, 3 ..... Worthington Pump & Machinery Corp
200,000 lb per hr at 1072 psig and 305 F, 3550 rpm, one dual drive
Boiler-feed-pump drives, 2 ..... Terry Steam Turbine Co
400 hp at 3550 rpm with 850-psig 900-F steam, 67 psia to 1-in. Hg abs backpressure
Boiler-feed-pump drives, 2 ..... General Electric Co
400-hp 3600-rpm 440-v direct-coupled motors
Low-pressure heater, 1 ..... Griscom-Russell Co
Vertical, 2-pass with stationary head down, U-tube; 1293-sq-ft effective surface. Raises 212,480-lb-per-hr water from 97 to 172.6 F
Intermediate-pressure heater, 1 ..... Griscom-Russell Co
Vertical, 4-pass with stationary head down, integral subcooling zone, U-tube, 1022-sq-ft effective surface. Raises 247,746-lb-per-hr water from 173.3 to 233.3 F
High-pressure heater, 1 ..... Griscom-Russell Co
Vertical, 4-pass with stationary head down, integral desuperheating and subcooling zones, U-tubes. Raises 281,440 lb-per-hr water from 289 to 355.7 F
Deaerating heater, 1 ..... Elliott Co
Vertical, direct-contact type, 325,000-lb-per-hr capacity, 12,000-gal storage tank, 67-psia pressure, 245-F temp at inlet
Evaporator, 1 ..... American Locomotive Co
Floating head, integral deaerator and steam wash system; 7000-lb-per-hr stor-vapor at 24.2 psia. Raw water in at 60 F, vapor at 238.3 F
Water-treating, zeolite softeners ..... Cochrane Corp

COAL AND ASH HANDLING:

Coal-handling equipment ..... Link-Belt Co
100-tons-per-hr capacity. Track hopper, reciprocating feeder, conveyor belts, vibrating screen, belt-bucket elevator, horizontal screw conveyor, chute, reclaim hopper. One conveyor belt, 24-in. wide, 102-ft centers, 200 fpm. 5-hp motor drive, 1800-rpm 1-belt conveyor, 24-in. wide, 73-ft 8½-in. centers, 200 fpm, 4 deg incline from horizontal. Horizontal screw conveyor, 80 rpm, sectional flight type, 18-in. dia, 65 ft long; 25-hp motor drive. Bucket elevator, 298 fpm, 110-ft 10¾-in. centers, 348 12x7 in. buckets, 25-hp motor drive.
Weightometer, 1 ..... Merrick Co
Concrete coal bunkers, 2, reinforcing steel ..... Truscon Steel Co
Coal bunkers, 2, lining (350 ton) ..... Anthracite Marble and Tile Co
Car thawing pits, 4 ..... Hauck Manufacturing Co
Low-pressure-air type oil burners
Locomotive, 18-ton, gasoline engine ..... Plymouth Locomotive Works
Ash- and dust-handling system ..... United Conveyor Corp
Two flooded ash hoppers, sluicing system, transport nozzles. One hydro-jet, horizontal pump with 1100-gpm capacity at 300-ft total head. Driven by 125-hp 440-v 1750-rpm motor

PIPING AND VALVES:

Blowdown valves — Yarnall-Warning Co
Nonreturn valves — Edward Valves, Inc
Piping contractor and fabricator ..... National Valve & Mfg Co
High- and low-pressure valves — Hancock Valve Div, Manning, Maxwell & Moore Inc; Crane Co; Walworth Co; Chapman Valve Manufacturing Co; Kennedy Valve Co; Atwood & Morrill Co; Reading Pratt & Cady Div, Am Chain & Cable Co; Henry Vogt Machine Co
Relief valves — Atwood & Morrill Co; Manning, Maxwell & Moore
Check valves — Edward Valves, Inc; Chapman Valve Manufacturing Co; Crane Co
Miscellaneous piping equipment ..... National Valve & Manufacturing Co
Plumbing ..... Evans Corp
Insulation — Universal Insulation Co

INSTRUMENTS AND CONTROLS:

Liquid-level controllers — Hanlon-Waters, Inc
Draft gages — Hays Corp
Flowmeters — Bailey Meter Co
Indicating-pressure gages ..... Manning, Maxwell & Moore, Inc
Recording-pressure gages — Bailey Meter Co
CO_2 recorders ..... Leeds & Northrup Co
Water-level recorders — Bailey Meter Co
Recording thermometers — Leeds & Northrup Co; Bailey Meter Co
Liquid-level indicators ..... Crosby Steam Gage & Valve Co
Thermometers — Moeller Instrument Co
Instrument boards ..... Leeds & Northrup Co

ELECTRICAL EQUIPMENT:

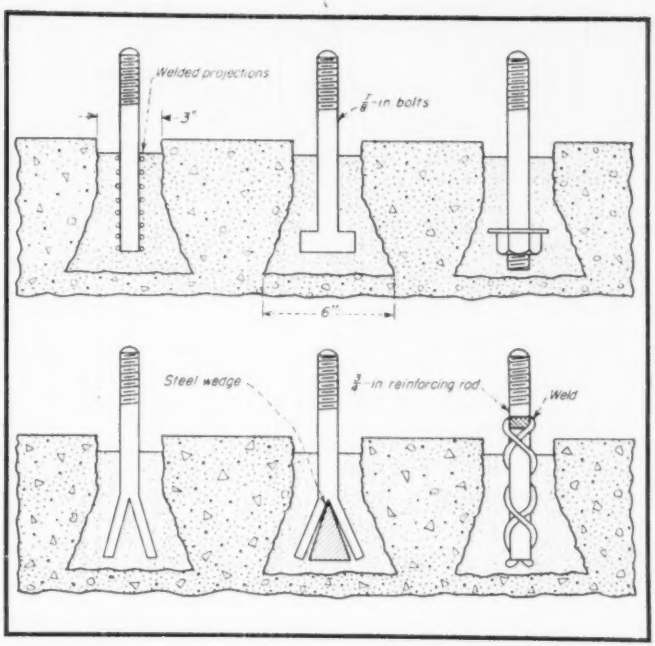
Electrical contractor ..... Sordoni Construction Corp
Bus, ducts and conductors — Elpeco; Kerite Co; Crouse-Hinds
Switchgear — General Electric Co; I T E Circuit Breaker Co
Main and instrument transformers — General Electric Co; Westinghouse Electric Corp
Circuit breakers, 110-kv — Westinghouse Electric Corp
Circuit breakers, 33-kv, 13.8-kv — General Electric Co
Circuit breakers, other — I T E Circuit Breaker Co
Outdoor switchyard — General Electric Co; Westinghouse Electric Corp; Railway & Industrial Engineering Co
Control switchboard ..... General Electric Co
Generator voltage regulator ..... General Electric Co
Spare exciter ..... Westinghouse Electric Corp
Battery-charging m-g set ..... Electric Products Co
Switches, pushbutton, selector, starting — Allen-Bradley Co; General Electric Co

MISCELLANEOUS EQUIPMENT:

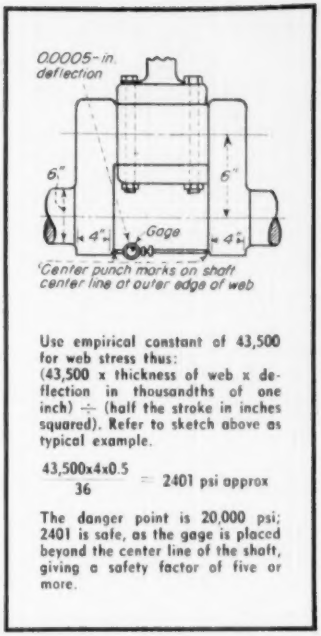
Ventilating fans, 17 ..... Steen Fan & Blower Co
Turbine room, three 21,000 cfm, 2-hp motor drive, boiler room, eight 28,800 cfm, 3-hp motor drive, hopper house, five 6840 cfm, ½-hp motor drive, screen house, one 4550 cfm, 1/3-hp motor drive
Turbine-room crane, 75-ton ..... Northern Engineering Works
Heating-boiler oil burner (emergency use) ..... Cleaver-Brooks Co
Heating system ..... Trane Co
Tanks ..... Tippett & Wood
Service-water pumps, 2 — Goulds Pumps, Inc
2-stage centrifugal, 500 gpm against 250-ft head, 50-hp 440-v motor
Well pumps, 2 ..... Deming Co
Single-stage centrifugal, 100-gpm against 200-ft head, 15-hp, 208-v motor drive
Service air compressor, 1 — Ingersoll-Rand Co
304-cfm, 100-psig, 60-hp motor drive
Instrument air compressors, 2 ..... Ingersoll-Rand Co
33.2-cfm, 100-psig, 10-hp motor drive
Laboratory equipment — Will Corp; Burrell Technical Supply Co
Fire extinguishers ..... Ansul Chemical Co
Fuel, No. 4 buckwheat anthracite ..... Philadelphia-Reading Coal & Iron
Vacuum cleaning ..... Spencer Turbine Co
Communication system ..... Gaitronics Corp
Building superstructure, substructure ..... Sordoni Construction Corp
Building brick ..... Binghamton Brick Co
Structural steel ..... American Bridge Co

CONSULTING ENGINEERS

Gilbert Associates, Inc



1 These six practical ways of grouting foundation bolts into old concrete can be depended on if the job is done right. Bolts usually stretch before pulling out



Use empirical constant of 43,500 for web stress thus: (43,500 x thickness of web x deflection in thousandths of one inch) ÷ (half the stroke in inches squared). Refer to sketch above as typical example.

$$\frac{43{,}500 \times 4 \times 0.5}{36} = 2401 \text{ psi approx}$$

The danger point is 20,000 psi; 2401 is safe, as the gage is placed beyond the center line of the shaft, giving a safety factor of five or more.

2 Equation for stress in psi, used by underwriter and insurance companies

Combine Know-How and Tools for Good Erection

A makeshift foundation, careless grouting and hit-or-miss erection lineup can only lead to shoddy performance of reciprocating machines. Insure your new equipment investment by fastening the unit true and solid to a substantial base

By W R PENDER
A M Lockett & Co Ltd, New Orleans, La.

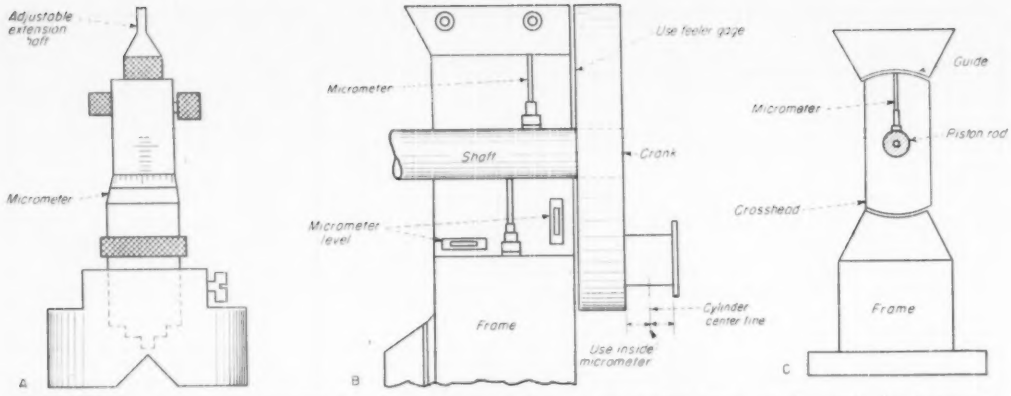
► RELIABLE OPERATION and low-cost maintenance of engines and compressors are dividend returns from skilled installation and assembly. Here the foundation plays an important part, especially when machinery is large and needs heavy supports. In general, I find that manufacturers furnish more or less conventional plans for the foundation, showing the location of bolts and other accessories.

Check Soil Loading. Unless specified, the manufacturer is not responsible for checking local subsoil characteristics. So the purchaser must investigate these conditions, taking into consideration foundation as well as machine weight to prevent future settling and misalignment. Various methods can be used to reinforce a standard foundation, such as driving wood, concrete or steel piling. Should the subsoil justify a less expensive foundation, an additional subconcrete "mat" to increase the bearing area will do the job. A good foundation is the first step in assuring satisfactory machine operation and low maintenance cost.

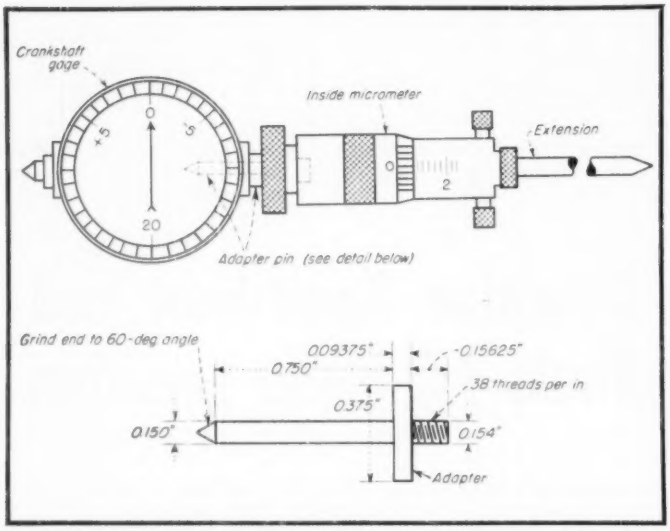
In some setups vibration transmitted to other machines or to the building can be troublesome. I have assisted in several installations that required compressors and foundations to be supported by heavy springs resting on a submat. The springs effectively dampened the vibration and prevented it affecting the main building. A vault-type foundation, lined with isolation cork, also effectively dampens vibration.

Bolt Clearances. Foundation bolts, which hold the machine solid, must be installed with a 2-inch clearance. Placing a pipe or tin cylinder around the bolt permits shifting the machine when aligning and leveling during erection.

Special Bolts. Installations on an existing foundation or heavy concrete floor can be effectively secured by drilling holes into the old concrete and



3 Attaching a micrometer to a magnetic base *A* makes it easy to square the micrometer with the work in lining up main shaft *B*, and leveling piston rod C. With this instrument, measurements within 0.0005 in. assure a perfect alignment



4 Combining a dial strain gage and inside micrometer makes a good instrument for measuring web spacing on multicylinder engines and compressors to check shaft

"grouting in" a special foundation bolt. Several years ago I tested the strength of foundation bolts grouted into existing concrete. Six types of bolts, Fig. 1, were tested by inserting them in 3-in. diameter holes, 12-in. deep, drilled into old concrete. Holes were larger at bottom than at top.

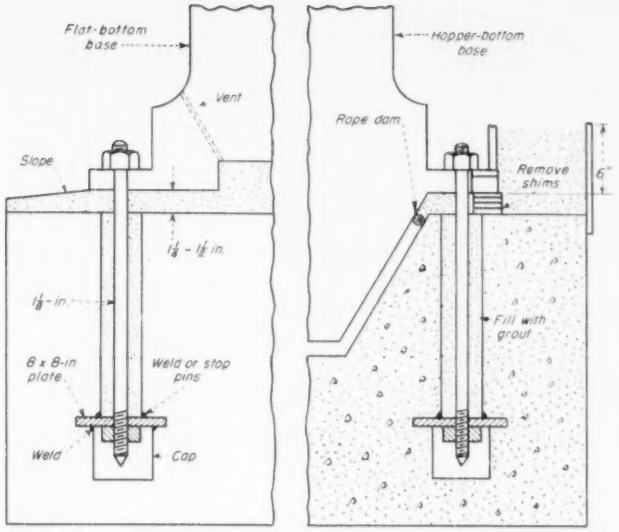
After the holes were cleaned and washed out, the bolts were grouted with a mixture of two parts clean sand and one part portland cement, mixed with water to pouring consistency. They were grouted in place one week before making the test. (After setting one week, cement should stand 2000-psi crushing strength.) All bolts broke or stretched, none pulled out of the concrete.

Erection. Usually large compressors, which require dismantling before shipping, have to be reassembled on their foundations. Before putting the bedplate in place, be sure top of foundation is cleaned and roughened so the grout will bond to the concrete. Foundation should be designed to leave 1½-in. space between machine base and top of concrete. Bottom of bedplate should be at least one inch above floor level to prevent waste oil and water seeping underneath and damaging the foundation material.

Place temporary shims or leveling wedges underneath the bedplate. Next, level the machine and align it with other shafts or driving equipment. A small amount of grease, paraffin or graphite, placed between the two top shims, makes it easy to move the base as required. After machine is level and almost completely aligned, final adjustment is made to place the unit in perfect operating condition. This is done in various ways. One method, required by insurance and underwriter companies, uses a special micrometer to test the crankshaft for internal strain or distortion.

Special Tools. By combining an inside micrometer and dial strain gage, Fig. 4, I developed a tool that is effective and easy to use. It double-checks the accuracy of the dial micrometer, and provides a method whereby correct tension can be applied accurately and positively. Thus it aids and perfects the strain or distortion gage when you check the crank-web spacing of diesel engines and compressors.

Referring to Fig. 2, make center-punch marks 1/16 in. deep on shaft center line and at extreme outer edge of crank web. Select proper length of extension to give about midway adjustment of micrometer gage. Place gage between web on center marks. Adjust micrometer to put 0.015- to 0.025-in. tension on the dial gage. Too much or too little tension affects readings. Set dial gage at zero and spin the tool between centers, until indicator hand does not move from zero. Check the dial gage by adjusting micrometer



5 For good installation provide plenty of movement for foundation bolts during leveling. Work a good mixture of grout into all crevices under the bedplate

(0.001 in. on micrometer should indicate 0.001 in. on dial gage).

Turn crank to measure top, sides and bottom of stroke. Note each on record. Always read dial when placed at same relative position of crank. Use a magnifying mirror and a light to read gage in obscure positions. The most effective use of the strain gage is obtained during the installation of diesel, gas or steam engines, and compressors. Faulty leveling affects the crankshaft. The generator or other machine to which the engine is connected can be effectively aligned to within 0.00025 in. Heavy flywheels and generator rotors deflect the main shaft unless compensation is made during leveling and alignment.

Magnetic Base. Another tool I designed is shown in Fig. 3. It is a special base that makes the inside micrometer easier to use when adjusting piston rods, crossheads, crankshaft, frames and main bearings.

Any micrometer will fit this base, which can be of magnetic material. The advantage of using it on compressor and engine alignment is that it positions the micrometer square with the work. The unit as a whole is easy to use for checking shaft position, Fig. 3*B*, and centering piston rod, Fig. 3*C*. It requires less skill to obtain measurements within 0.0005 in. for perfect alignment of compressors and engines. The micrometer can be removed from the base for other work, and the base used to hold other instruments.

Other tools and instruments required in erecting and servicing machines are: micrometer level, feeler gages, micrometer dial gage, straight edges, fine steel wire, targets, etc. The dial strain gage assists in the final alignment and leveling.

To complete the assembly, inspect and tighten all bolts and bearings. Check the clearance, adjust piston on double-acting machines to equalize cylinder clearance. In very long machines the piston requires adjustment to compensate for expansion of piston and connecting rod.

Piston Rod. Mechanical condition of a compressor has a great influence on piston-rod-packing life. In the double-acting horizontal crosshead compressor or engine, the piston rod should travel in a true horizontal plane. Remember the piston is not truly centered in the cylinder. Being somewhat smaller than the cylinder, the piston head travels back and forth slightly below center. So if the crosshead is set in the center of the frame, the piston rod travels in a slightly inclined plane, riding on the packing during part of the stroke.

The correct method of leveling and aligning the compressor or engine is to adjust the crosshead so piston rod travels slightly below center but in a straight line. Fig 3*C* shows how the micrometer and base attachment are used to check and adjust the piston rod so it travels in this path. A micrometer level is also necessary to check with the micrometer.

Grouting. After the machine is correctly leveled and aligned, space between base and foundation must be filled with a mixture of sand and cement or other approved grouting material. I prefer a mixture of two parts clean sharp sand and one part portland cement, mixed with water to the proper consistency for free flowing. Mixing and application must be done correctly, otherwise results will be poor.

Grouting is such an apparently simple process that it is often neglected and the job given to someone not well versed in the requirements. If we consider the expense of the design and work done on the foundation, and the cost of the machine, it is apparent that all may be lost if the final setting and grouting are neglected.

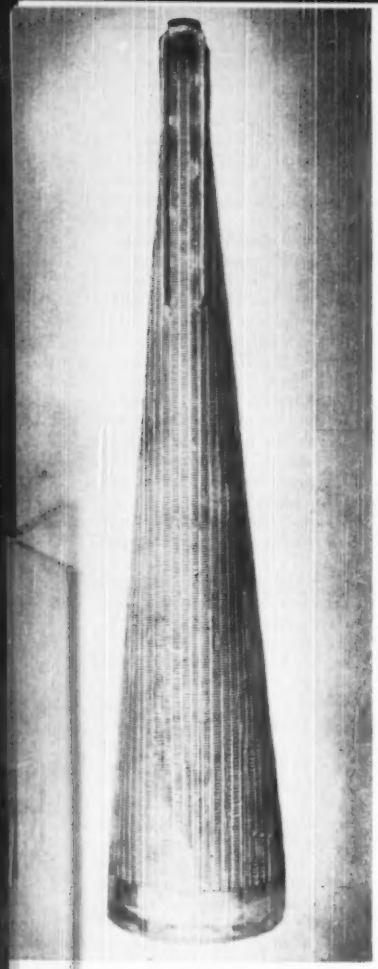
Fig. 5 shows approved grouting methods, whose principal requirements are as follows:

1. A clean and rough foundation top.
2. Highest-quality sand, cement and clean water mixed to flow. Use two parts sand and one part cement.
3. Height or *head* of grout above bottom of base, 6 in. minimum.
4. Depth of grout between base and top of foundation on narrow machines, minimum 1 in., maximum 2 in., best average 1¼ to 1½ in.
5. Fill space around foundation bolts with grout six to eight hours before grouting under base. This permits grout around bolts to complete shrinkage.
6. Remove excess grout on outside of base eight hours after grouting.
7. Fit bolts with bottom plate and steel or tin casing. Weld lower nut to plate, to permit removal of bolt.
8. Remove temporary support shims or wedges one week after grouting. Fill space with grout.
9. Finish top of foundation, sloping away from base ¾ in. to the foot. Drainage must be away from base so water and oil cannot enter between base and top of foundation.

Preparation of foundation top for grouting is vitally important. To assure a good bond roughen the surface by chipping, and remove all signs of oil and grease. Clean machine base and sole plates by removing scale, oil and grease.

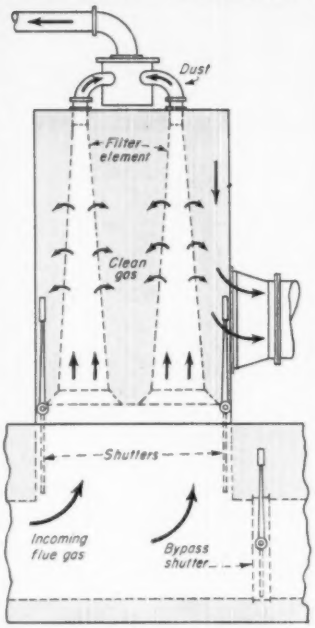
Keep the foundation top wet for several hours, and wet metal parts just before pouring grout. Be sure to remove excess water. The moist surfaces prevent absorption of water from the grout and act as a lubricant to facilitate flow of the mixture into all crevices of the machine base.

Wood forms for grout must be made of heavy lumber, solidly braced to withstand the weight of the grout and the manhandling needed to work it into place under the machine.



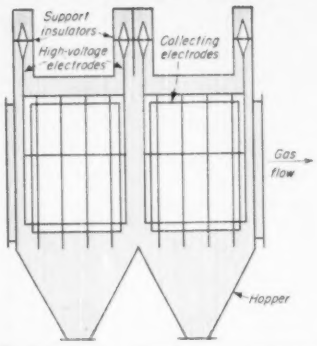
1 Cone-shaped laminated-steel dust separator takes flue gas in at wide end

MECHANICAL SEPARATION

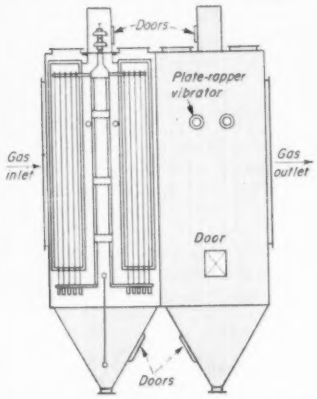


2 Flue gas can pass through laminations, above; dust is pulled out narrow end

ELECTROSTATIC DESIGN...



3 Simplified electrostatic collector shows basic relation of electrodes



4 Horizontal flow unit has perforated plate electrodes; 8¾ in. centers

Here Are the Working Tools for

By L N ROWLEY, *Executive Editor*
And J C McCABE, *Associate Editor*

Keeping your plant stack within the nuisance limits of today's smoke ordinance means intelligent use of the dust collectors on the market. This conclusion of a 2-part survey helps you make your selection

► WE BEGAN our discussion of dust-collection methods and designs available back in November POWER, pages 78-81. We had progressed from the simple mechanical baffle and cinder traps to the latest in cyclone-style collectors.

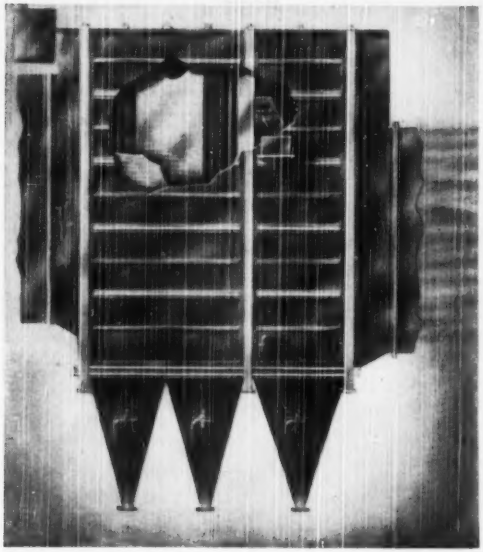
There is still another mechanical removal method, Fig 1. 2. Separating element is a series of laminated-steel plates made up in a cone. This cone goes into a steel casing normally placed between boiler flue-gas outlet and induced-draft fan, Fig. 2.

Dust-carrying gas can then enter the cone's wide opening. Once inside, gas escapes through the laminations and proceeds to inlet of induced-draft fan. But to pass through laminations, gas has to change direction sharply. Entrained solids stay behind in the cone under influence of the motion from the entering gas stream.

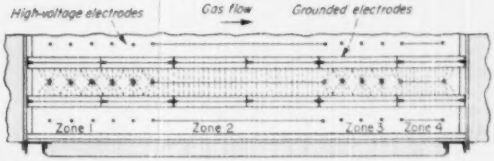
As the dust particles approach the top of the cone they are caught up in the suction of a secondary fan and pulled out at the top. This fan delivers flue dust either to a secondary separator or to a recirculating system for return to the furnace zone.

Electrostatic Precipitation. A widely used method of flue-dust removal, particularly for pulverized-coal furnaces, is the electrostatic precipitator, Fig. 3-7. This device performs several basic functions: It (1) electrically charges dust particles traveling in the gas stream

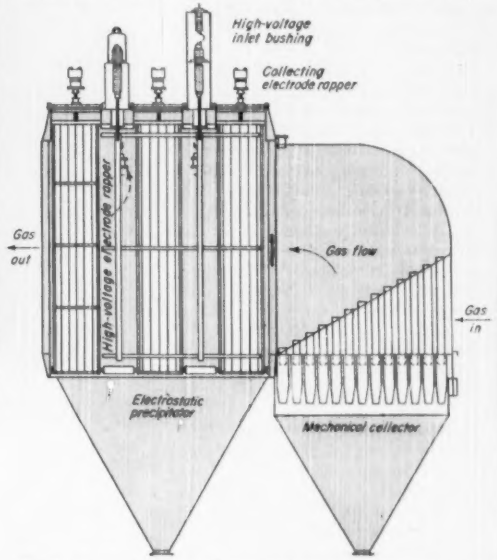
...HAS LONG RECORD OF HIGH-EFFICIENCY COLLECTION ON LARGE-SIZED BOILERS



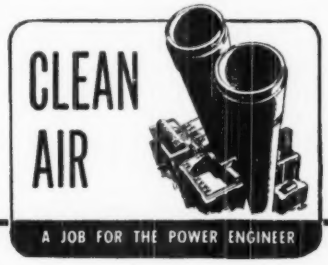
5 Two-stage unit has high-voltage wire for charging electrode; flat plate for precipitating; screen for collecting



6 First stage, Fig. 5, builds up particle charge rapidly; the next has uniform field to speed precipitation of dust



7 Series combination of mechanical and electrostatic collectors has become quite important in many applications



Flue-Dust Collection—Part II

(2) drives them to a ground or collecting electrode, where it discharges them (3) removes collected material from electrodes.

Performing all these operations on a fast-moving gas stream is not easy. A high unidirectional voltage has to be set up. Opposite the high-voltage discharge electrode, usually a small-diameter wire or a twisted square steel rod, is a grounded or collecting electrode. These are bare essentials. Fig. 3.

For any given wire diameter and electrode spacing there is a critical voltage. Above this voltage, an electrical discharge forms in the air or gas surrounding the high-voltage element. A bombardment between gas molecules begins. Electrons are torn loose from gas atoms or molecules. Once loose, the electrons combine with other atoms to produce negative ions. These follow electrostatic fields of force to the grounded electrode.

Any suspended dust particles in the gas stream become a target for these loose ions because the particles have a higher dielectric constant than gas or air. So the ions attach themselves to these dust particles and in doing so give them a negative charge.

Once you establish a sufficient charge on a particle the electrostatic field force regulates its movements. Force exerted is proportional to product of charge on the particle and electrical-field strength between high-voltage and grounded electrodes.

Let's say now that all dust particles in the flue gas carry a charge and are being pulled out of the gas stream. Next step is to collect the dust. Usually when the charged particles reach the grounded or collecting electrodes the charge leaks off to ground. Dust hangs on by mechanical adhesion.

Some designers, Fig. 5 and 6, feel the jobs of charging dust particles and then collecting them should take place separately. So they divide the precipitator into zones. High-voltage zone is designed to give maximum charge to all particles as fast as possible. Then the collection zone can be engineered for

a uniform high intensity to give effective collection at reduced power.

The higher the voltage applied, the more thorough the charge saturation on the particles and the stronger the electrical field—all of which means the shorter the time needed. But there is a definite practical limit to how high applied voltage can go. Some of the limiting factors, in addition to electrode spacing, are temperature, density, chemical composition of gas passing through collector.

How do you go about producing required unidirectional high voltage? It has to be anywhere from 30,000 to 100,000 v. Besides a high-voltage transformer, input ac energy has to be rectified. Here there is a choice of rectifier methods—mechanical or electronic.

Mechanical rectifier usually consists of a disk of insulating material. On the disk are 90-deg conducting arcs set 180 deg apart. Four stationary contacts, 90 deg apart, are: one high-voltage precipitator cable terminal, one grounded terminal, a pair of transformer secondary terminals. Disk is motor driven at synchronous speed so voltage at the stationary high-voltage terminal is rectified.

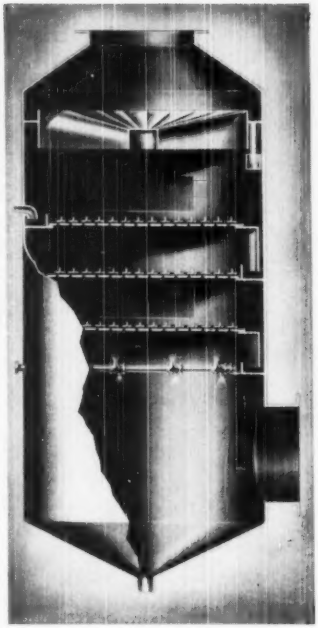
Electronic rectifier employs the high-voltage Kenotron tube. For large precipitators a 4-tube high-vacuum hot-cathode diode circuit is often used. Designs on the market, based on long tube life with certain circuit safeguards, assure good tube performance.

Practical Aspects. Now that we have the elements of an electrostatic precipitator, how about practical angles? One of the most critical needs for good performance is uniform gas-velocity distribution through the collector. A small section of a precipitator operating with a gas flow considerably above rating suffers because already-collected particles are swept back into the gas stream. Other areas handling a gas velocity below rating and turning in excellent performance cannot make up for this loss.

Suitable design overcomes two other inherent difficulties of electrostatic precipitators: their failure to collect or hold particles that (1) are large (2) have high carbon content.

The answer to the large-particle problem is to: (1) allow enough time in the precipitating field for the electrostatic force to overcome the inertia of the particle in the direction of gas flow (2) design a collecting electrode to prevent the large particle from "balling up" with its neighbors and rolling along the electrode and out through the unit.

The high carbon-content particle presents quite another problem. Here the job is largely one of holding the carbon particle when first precipitated.



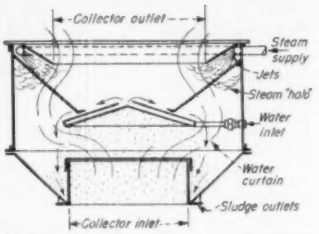
Since carbon is somewhat of an electrical conductor, the carbon particle takes on its charge quickly enough. In fact, its saturation charge approaches three times that of a normal ash particle.

But because the carbon is conducting, it behaves far differently from normal collected dust. Carbon loses its charge rapidly to the grounded electrode. But the now uncharged particle is still under the influence of the high-voltage elements opposite. Result is the carbon particle gives up some of its own negative ions to the grounded electrode. This action, charging by induction, leaves the collected carbon particle with a slight positive charge.

This weakly charged positive particle feels the pull of the negative high-voltage electrode. So it leaves the grounded electrode and reenters the gas stream, where it comes into a field filled with negative ions. Once again the particle takes on a negative charge, returns to the collecting electrode. But the same charging-by-induction phenomenon occurs and the cycle begins again. This zigzag path of the carbon particle may continue until it passes completely out of collector.

Solution for this difficulty—charging by induction—must be through some method of reducing influence of high-voltage elements on the collected particle. Reduction may be either through

MOST GAS SCRUBBERS...



9 Low-cost flue-gas scrubber directs gas through water before discharge

8 Multistage gas scrubber *(left)* has gas flow counter to the scrubbing water

a reduced field intensity in the collector element's neighborhood or a collector element that makes reentrainment physically impossible.

The reentrainment problem is most aggravated when time comes to remove any collected material from the electrodes. Today's power plants can't shut down just to clean out dust collectors. Yet the material must be constantly removed to permit top collection efficiency.

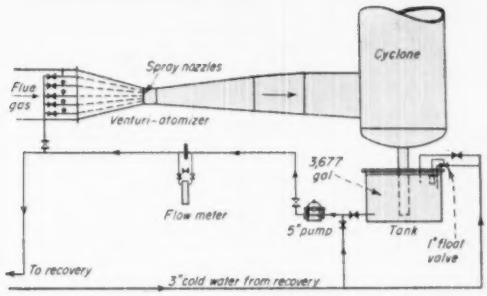
Both high-voltage and collector electrodes take on coatings of flue dust. The high-voltage element, if a wire, has its effective diameter increased by the coating. This reduces the effective corona discharge and lowers operating efficiency. In addition, dust build-up increases normal rate of flashovers within the precipitator.

Just how to effect this removal is the subject of much research. In general, electrodes, both high-voltage and collecting, are rapped. But methods, areas rapped and controls over reentrainment vary considerably.

Proper vibration of electrodes can remove practically all dusts. So they must not be too rigid or too heavy in cross section. Any rapping must be timed so successive impacts do not interfere with electrode vibrations already set up. This means automatic rapping, by air- or motor-driven rappers. Contactors or motor starters can be so set that no two electrodes are rapped together. Or dampers can be closed to isolate sections undergoing rapping.

Fig. 3 shows the bare essentials of a horizontal gas-flow collector. The high-voltage ionizing electrodes are supported by insulators so there is no danger of arcing over to the precipitator casing. Further, these electrodes are accurately centered between collecting electrodes so peak voltage and peak

...SERVE WELL IN WET COLLECTION OF GAS-BORNE SOLIDS



10 Venturi scrubber, Fig. 9, applies controlled water spray at throat, and separates moisture and gas in the cyclone

performance can be maintained. Should the high-discharge electrode be closer to one collecting electrode than to its neighbor, there is danger of too frequent arcing over.

Thus, it is important that the supporting structure be stable. So single- and 2-point suspension is sometimes used by hanging weights on the bottom ends of the discharge electrodes. These weights prevent swinging.

Collecting electrode has several designs. It must not buckle or warp because this defect reduces electrical clearance, causes the same trouble as a swinging high-discharge electrode. Physical shapes of collecting electrodes vary widely: (1) rod-curtain designs made up of curtains of small-diameter pipes hung vertically in a horizontal-flow precipitator (2) corrugated-plate curtains of corrugated sheet iron (3) dual plates made by welding steel sheets to the two sides of a frame with retaining holes punched out in the sheets (4) pocket electrodes with V-shaped strips hung vertically so the V's apex faces the gas stream (5) special high-duty collectors using bent steel strips hanging from each side of a frame to make a dust spout between electrode's sides.

Still another design, Fig. 5 and 6, has its pocket electrode employ a flat plate with a 1½-in. mesh screen spaced 1½ in. from plate. This arrangement permits concentrating the electrostatic lines of force on the screen. As a result, field intensity between collecting electrode plate and screen runs much less than outside the screen. So the tendency of carbon particles to be charged by induction is prevented and their reentrainment stopped.

Series Arrangements. A growing tendency combines mechanical with electrostatic collectors, puts them in series, Fig. 7. There is considerable discussion over which should lead—mechanical or electrostatic. Here are pertinent facts.

At the moment the strongest single point in favor of the mechanical collector as a leader is that it works on the "whole" dust and at typical dust grain loadings. So its performance is as good as the mechanical collector alone. Then the electrostatic need handle only that dust portion on which it is most capable —the fines. Further, during soot blowing when grain loadings reach 200 to 300 gr per cu ft the mechanical collector operates at about the same efficiency. It again relieves the electrical unit, which then does not have to supply the required negative ions for adequately charging the heavier dust loading.

One difficulty this arrangement, Fig. 7, creates is emptying out the electrostatic precipitator hoppers. Dust is so fine it may bridge, but proper hopper design can correct this.

With the electrostatic unit trailing the mechanical, material lost during rapping may be emitted from the stack. This is the strongest claim made by those who advocate putting the mechanical collector in the "back-up" spot. How important this consideration may be depends on the way the rapping is carried out and how much of a problem, if any, it creates.

Gas Scrubbers. Fig. 8-10 show equipment employing a very different system for cleaning up a gas stream. In these the dirt-laden gas is passed through an apparatus designed to trap suspended solids in a scrubbing liquid, usually water.

In each scrubber, there are one or more basic principles: (1) impingement of gas stream against water droplets or wetted surfaces (2) centrifugal action to separate particles from the gas stream (3) a breaking up of gas into small streams. Separation then occurs.

Fig. 8 receives gas at lower section of scrubber. The gas rises through a curtain of water created by a number of low-pressure sprays. These humidify the gas, strip it of coarse dust. Then the impingement plate (600 to 3000 holes per sq ft) and baffles above each plate receive the gas.

As the gas goes through the perforations it speeds up and at the highest velocity it strikes the water-shielded baffle. Here the greatest cleaning action takes place. All suspended matter tends to travel in a straight line and impinges against the under surface of the wetted baffle. It is then trapped in the scrubbing water and carried out.

Fig. 10 illustrates a newcomer to the gas-scrubbing field — the venturi scrubber. It offers a means for injecting a low-velocity scrubbing liquid into a high-velocity stream of dirty gas.

The gas impinges upon and disrupts the rather large jets of liquid so the drops of liquid accelerate and disrupt still further. Some liquid atomizes, at least briefly. Then the gas and vapor mixture slows down and the two are separated in an eliminator, Fig. 10.

Four collection methods are possible in the venturi setup: (1) collision (2) diffusion or molecular bombardment (3) electrostatic effects (4) condensation. Collision and diffusion, the manufacturer feels, are the most important.

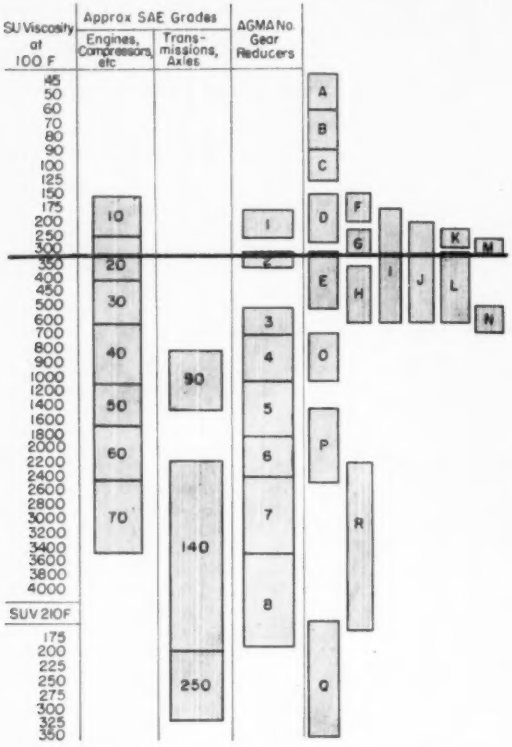
Relative velocities of suspended particles to the water droplets go from 125-400 fps at first impact. This drops rapidly as the water accelerates and opportunities for collision are excellent. Downstream in the expansion section the gas slows down. Water droplets may for a time have higher velocities than the solids, which increases opportunity for collision. The droplets coalesce and much of the liquid leaves the venturi as solid water, the rest as fog or vapor.

As soon as gas impinges on the liquid, and right afterward, resulting turbulence produces 5 to 25 sq ft of droplet surface per cu ft gas. This makes collection by diffusion an important part of overall performance. Further, these liquid droplets are known to be charged; hence electrostatic action plays some part.

Although no installations of this equipment have been made on boiler flue gas, the manufacturer feels such an installation can be made economically.

Fig. 9 represents a relatively low-cost method for scrubbing a boiler flue gas. Here water runs over a plate through which the gas passes. The water then continues over the sides, making a fairly solid water curtain, within which the entering flue gas is channeled. A steam spray is introduced near the outlet to overcome draft loss through the collector.

RELATION BETWEEN OIL STANDARDS AND TYPICAL INDUSTRIAL APPLICATIONS



VARIETY OF OILS used in the plant may be reduced by taking note of relationship between SAE, AGMA, viscosity. In addition to this connecting link between standards, notice list of recommended lube applications. Above chart was prepared after checking recommendations of leading machinery manufacturers

RECOMMENDED LUBE USES

A
Spindles—High Speed

B
Spindles—Medium Speed

C
Spindles—Slower Speed

D
Electric Motors and Motor Generators OF-120F

—
High-Speed Chain-Belt Drives, OF-120F

E
Gear and Piston Type Pumps, 120F–180F

F
Direct-Connected Turbine Generator Sets (Circulating System)

—
Machine-Tool Circulating Systems

—
Vane-Type Hydraulic Pumps With Flow-Control Valves

—
Gear and Piston Type Hydraulic Pumps 0F–70F

G
High-Speed Chain-Belt Drives, 120–180F

H
Roller, Silent-Chain Jaw-Type Flexible Couplings Between 0F and 70F

I
Steam-Engine Circulating Systems

—
Roller and Silent Chains and General Lubrication on Stokers

J
External Lubrication of Steam Engines and Steam Pumps

—
Machine Tools—Automatic Systems, General Lubrication of Slides, Ways, Bearings, etc

—
Shafting — Oil-Lubricated Bearings

—
Chain-Belt Drives—Medium Speed, 0F–180F

K
Vane-Type Hydraulic Pumps Without Flow Control Valves, 0F–180F

L
Steam Turbines, Ring-Oiled Bearings Without Cooling or Circulating System

—
Chain Belt Drives at Slow Speeds 0F–180F

M
Steam Turbines Geared With Circulating System

—
Steam Turbines, Ring-Oiled Bearings With Cooling System

—
Gear and Piston Type Hydraulic Pumps, 70F–120F

—
Electric Motors and Motor Generators, 120F–180F

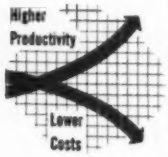
N
Flexible Couplings of the Roller, Silent-Chain and Jaw Types, 70F–120F

O
Flexible Couplings of the Roller, Silent Chain and Jaw Type, 120F–180F

P
Flexible Couplings of Gear, Floating-Key and Flexible Pin Types, 0F–70F

Q
Extreme Heat Conditions

R
Flexible Couplings of Gear, Floating-Key and Flexible-Pin Types, 70F to 180F



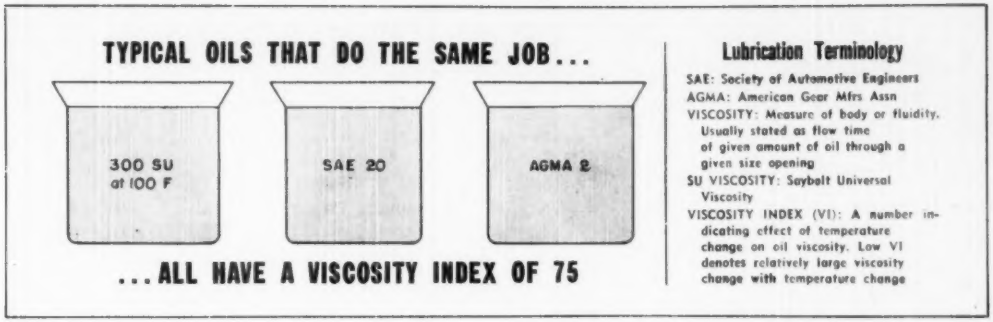
Simplifying Plant Lubrication

BY J G O'NEILL Jr, *Lubrication Engineer, Sinclair Refining Co, New York City*

Reducing number of lubricants is first step in cutting lube-oil costs. Here's the tie-in between viscosity, SAE and AGMA. Included is a tip-off on the oils for typical uses

► THERE ARE TWO UNFOUNDED IDEAS that must be discarded before tackling the lube-simplification job. "Oil is oil" was a common expression from the middle of the nineteenth century up to the early 1900's. Then as this century got well under way, the pendulum swung in a wide arc. And at the present time we find many oils being used, each with supposedly special properties.

The large number of lube oils used at present stem direct from rapid simultaneous growth of machine development and oil refining. The refiner markets new oils for each machine developed. Then again, the machine manufacturer takes the stand that every new mechanical unit is quite different from the others, hence requires special lubricating oils.


TYPICAL OILS THAT DO THE SAME JOB...
300 SU at 100 F
SAE 20
AGMA 2
...ALL HAVE A VISCOSITY INDEX OF 75
Lubrication Terminology
SAE: Society of Automotive Engineers
AGMA: American Gear Mfrs Assn
VISCOSITY: Measure of body or fluidity. Usually stated as flow time of given amount of oil through a given size opening
SU VISCOSITY: Saybolt Universal Viscosity
VISCOSITY INDEX (VI): A number indicating effect of temperature change on oil viscosity. Low VI denotes relatively large viscosity change with temperature change

To give the devil his due, these demands are frequently justified. But more often they are founded on misinformation or blind faith in certain oil qualities. At the present time, we're at the point where even the lubrication engineer often finds it tough to keep track of all the properties of all the oils.

Operator's Problem. Recommendations in instruction books and machine nameplates are generally confusing to the operator. One machine manufacturer recommends oil by brand name, another by viscosity at either 100-, 130- or 210-F. You'll find a third lists by SAE grade, while a fourth specifies by AGMA number. If the operator tries on his own to reduce the number of lubricants, he runs into a snag interpreting the various standards. On the other hand, if he follows the recommendation of each machine manufacturer it means keeping just that many more lubricants on hand.

Besides keeping track of many different oils, there is an additional problem of supplying a separate dispensing rig for each product. Also, there is the matter of making certain each oil is applied to the right machine at the proper time-interval.

Our Solution. We realized that a simplified approach was needed for 90% of existing machinery. Our first step in that direction was to consult leading machinery manufacturers. Various mechanical units were classified, and the type and viscosity range of the required oils listed. It soon became apparent that many machines could use the same oils.

Armed with this information we started surveying plants to reduce the number of lubricants used. In one large plant, 376 were required if the machinery manufacturer's recommendations were taken literally. It turned out the job could be done well with but 15. In another plant, nine products supplanted 99 already in use. In the course of a few years many plants, large and small, benefited by cutting operating costs and increasing operating efficiency.

The lubrication chart, p. 86, shows the relationship between the various oil standards, in addition to the viscosity ranges accepted by leading machinery manufacturers. This connecting link alone does much to clear up misconceptions about SAE grades, AGMA numbers and viscosity ranges for specific applications.

Studying the chart for a few moments shows that the various oil classifications are often related to each other. Remember that this chart does not include all oils. But it does cover the more generally used large-volume items. Keep in mind the chart is based on average oils used in industry. Hence the *Viscosity Index* of 75.

SAE scale and several of the heavier AGMA numbers would have to be adjusted where specific oils, such as those of naphthenic derivation, are used. But little change would be required in the application ranges because of varied Viscosity Indexes.

Putting Chart to Work. It's easy to use this chart. For example, a line drawn horizontally through *300 Viscosity* intersects *SAE 20, AGMA 2* and a host of applications. This means that an oil of 300 seconds Viscosity is an SAE 20, an AGMA 2, and can be used on all the applications represented by the intersected blocks. The same procedure is followed for any viscosity. Not only is the relationship between Viscosity, SAE and AGMA established but an insight is given on applications.

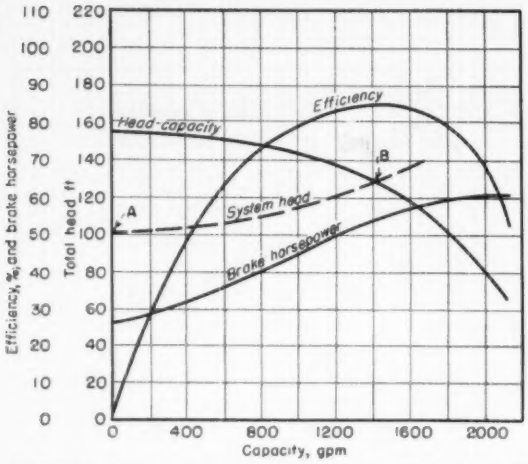
Note how the chart clears up relationships even within a specific classification. For example, an SAE 50 is also an SAE 90. An SAE 70 is also an SAE 140. Another interesting point is brought out by the bulk of applications fitting between 150 and 600 seconds. This puts volume oils right in this range.

But there still is confusion because of the differing standards describing petroleum products. They must be interpreted for industry by trained individuals. This is one impediment to efficient simplification.

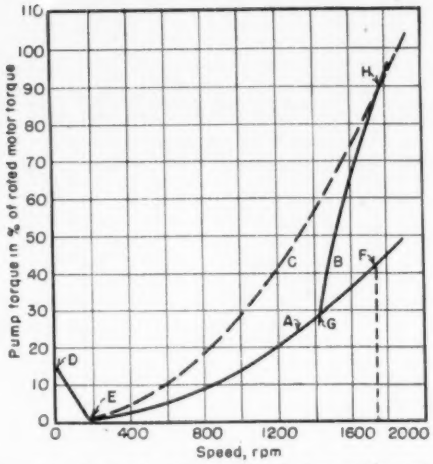
Keep in mind that this chart doesn't indicate quality. In a simplification program quality-oil selection is based on the needs of the most critical unit. For a 300-second oil it should be based on the steam turbine or the hydraulic system. After oil is selected on a quality basis for the most critical unit, it is then used in the other not-so-critical machines. If there are machines that waste oil they should be segregated and, if possible, lubricated with inexpensive, general-purpose or red engine oil.

Simple Economics. At first glance this system may appear impractical from a cost angle. You may come to that conclusion because certain units will be using oil superior to that normally required. After thinking it over, however, you will notice that, while in a few instances oil costs have been increased, the number of lubricants has been greatly reduced. It's this cut in the number of products that reduces storage, dispensing equipment and labor costs. Furthermore, it has decreased confusion in lubricant application with resultant decrease in mechanical failures and maintenance costs.

An important angle on purchasing is that simplification makes it possible to buy oil at a lower price. For instance, when a number of small-volume oils are used, they are normally bought in light, iron barrels. When one oil replaces five, six or even more oils, the volume of the one item increases in proportion. It may then be possible to install a storage tank and buy by either tank-wagon or transport-truck deliveries. Lower cost of these delivery methods quickly pays for the storage tank, along with yielding actual savings. And when tank storage is used, the oil can be piped to the actual points of use. This alone means a saving in handling and labor costs.



1 Characteristic curves for 6-in.-discharge single-stage double-suction volute centrifugal, and system head curve



2 Torque curves of 6-in. pump in Fig. 1 show unit's starting-torque needs for three different starting conditions

How Much Torque Is Needed to Start

Here are results of a study* of starting-torque requirements of three centrifugal-pump designs—radial, mixed and axial flow. It shows effects of pump type on motor torque needed to start from rest and bring the pump up to operating speed

► PROPER SELECTION of a power unit to drive a machine requires study of the machine's starting characteristics. Because centrifugal pumps are comparatively easy to start, selecting their drives rarely causes worry. But when a pump is connected to long lines of limited capacity, motor and control selection sometimes require study of the unit's starting-torque needs.

Starting Time. Time needed to start and bring a load to speed depends on (1) margin of torque available to accelerate the load (2) mass or flywheel effect of rotating parts to be accelerated. Centrifugal pumps have a low flywheel effect and low starting-torque requirements, so high-starting torque motors are not needed to drive these pumps.

Theoretically, any torque no matter how small should start a centrifugal pump from rest. But this is not so because of friction of bearings and stuffing boxes. During shutdown of pumps with sleeve bearings, oil squeezes out from between the shaft and the bearings to put them in metal-to-metal contact. Also, when a pump stands idle the packing tends to grip the shaft, if it is not lubricated by water from the seal.

Static Friction Load. To overcome bearing and packing friction the required breakaway torque depends on (1) design of pump bearings (2) type and condition of packing (3) tightness of packing gland (4) how long the pump has been shut down. But torque required to start a pump in operating condition is always less than 20% of that needed to drive it under design conditions.

Usually 15% is assumed for horizontal-shaft pumps with babbitted-bearings and 10% for antifriction-bearing pumps. A general rule cannot be given for how soon conditions causing break-away torque disappear after the pump begins to rotate. It is safe to assume that this torque decreases as speed increases from zero to 10 or 20% of rated value.

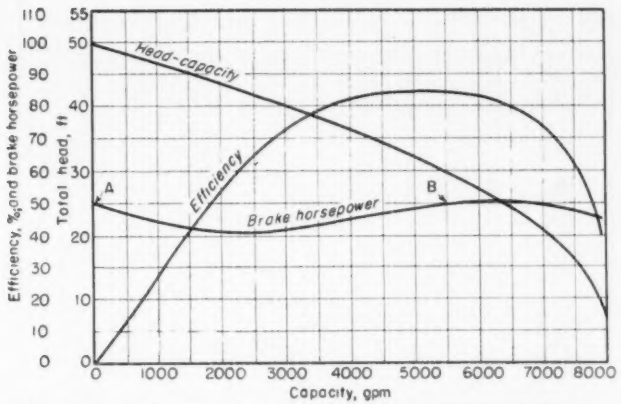
Low Specific-Speed Pumps. Most centrifugal-pump applications involve relatively low specific-speed types, which are usually started against a closed valve. Fig. 1 shows the characteristics of such a pump. If it is operated against a closed valve, shutoff power at any speed is proportional to the ratio of the speeds cubed. The torque varies as the square of the speed ratio, curve *A*, Fig. 2.

Break-Away Torque. In Fig. 2, breakaway torque needed to overcome bearings and packing friction is assumed to be 15% of normal torque required to drive the pump, point *D*. It is also assumed that when the pump reaches a speed of 177 rpm, bearing and packing friction will have fallen to near zero and, consequently, the required torque has also decreased to a like value, point *E*. Beyond this point the required torque to drive the pump with closed discharge increases along curve *A*.

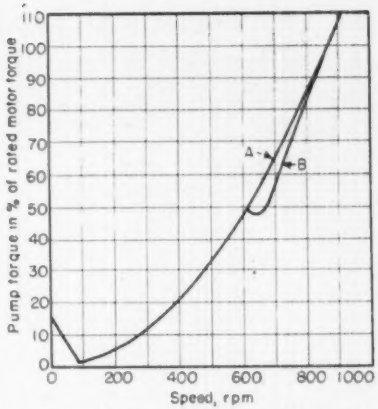
Motor and pump operate at 1770 rpm, a speed at which the pump requires about 43% of motor full-load torque, point *F*. Torque values obtained from curve *A* are those required to drive the pump with no excess for acceleration.

Assume the pump is started on a system with 100-ft static head, Fig. 1, against a closed check valve with open gate valve. During starting the pump operates against shutoff until it reaches a speed where the shutoff head exceeds 100 ft static, point *A*. Here the check valve begins to open and flow starts through the pipe. To cause this flow, some excess head is required, but for starting-torque considerations it can be

*This article is based on a paper awarded first prize in the *Practical Papers Group*, submitted in the Sixth Annual Engineering Essay Contest of the Hydraulic Institute, New York, N Y.



3 Constant-speed characteristics of 870-rpm 16-in. medium specific-speed centrifugal pump with mixed-flow impeller



4 Torque curves of pump in Fig. 3. Curve *A* is for starting against closed discharge; *B* against 25-ft static head

Centrifugal Pumps?

By **ROY CARTER**, *Application Engineer*
Worthington Pump & Machinery Corporation

ignored. It can be assumed that during the rest of the starting cycle, pump capacity follows the system-head curve, Fig. 1.

When starting the pump under conditions of Fig. 1, the required torque follows along curve *A*, Fig. 2, to 1425 rpm, point *G*. Here the pump develops 100-ft head, which equals the static head on the system. As speed increases the pump delivers an increasing volume of water through the system until at full speed, the volume is 1400 gpm, where the system-head curve meets the head capacity curve, point *B*, Fig. 1. Curve *B*, Fig. 2, shows the torque required to drive the pump until it is delivering 1400 gpm.

System Friction Head. Assume the pump is used on a system where the head is caused entirely by friction of water flowing through the pipe. Here the operating conditions are the same as in the previous problem, 1400 gpm and 129-ft total head. The pump is started against the quick-opening check valve with the gate valve open. Ignoring acceleration of the water column, flow would start immediately. For all practical purposes, flow would be directly proportional to the speed ratio, head proportional to the square of the speed ratio, power to the speed ratio cubed and torque to the speed ratio squared. On this basis curve *C*, Fig. 2, shows the torque-speed relation. This curve meets curve *B* at *H*, the pump capacity under operating conditions.

Medium Specific-Speed Pumps. It is feasible to establish approximate torque-speed curves for any centrifugal pump if its characteristics and method of starting are known. Take a medium specific-speed type pump that requires the same horsepower (50 hp) at shutoff as at point of maximum efficiency, points *A* and *B*, Fig. 3. Speed-torque curve for this pump will be practically the same whether it is started against a closed gate valve or a check valve. With the latter, it would make little difference if the system were all static, all friction or part static and part friction.

Fig. 4 shows pump torque plotted against speed. Curve *A* gives the torque required when starting against a closed gate valve, also when starting against a check valve on a system where the head of 25 ft at 6370 gpm is all friction. If the pump were operated against a system having a 25-ft static head, the torque-speed curve would be like *B*, Fig. 4. For any system with combined friction and static heads, the torque-speed curve would be some curve falling between curves *A* and *B*.

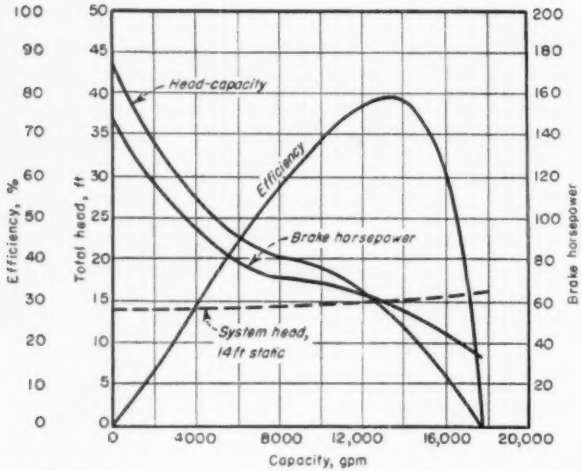
Propeller Pumps. For low-head applications, the propeller-type pump is used extensively. It is a high specific-speed type with a mixed-flow or true axial-flow impeller. Fig. 5 shows typical characteristics of one design with an axial-flow impeller, having shutoff horsepower about 2.5 times that required at maximum efficiency.

Many of these pumps, especially those over 9000 specific speed, have an unstable portion in their head-capacity curves. When these units are used, maximum operating head should be below the unstable range. The pumps should either be installed on a siphon system or started against a check or flap valve. The pump, whose characteristics are given in Fig. 5, might be one of several controlled by float switches stopping all pumps when the suction level was pumped down to give 16-ft static head with maximum discharge levels. The pumps would normally be started at different water levels in the suction well.

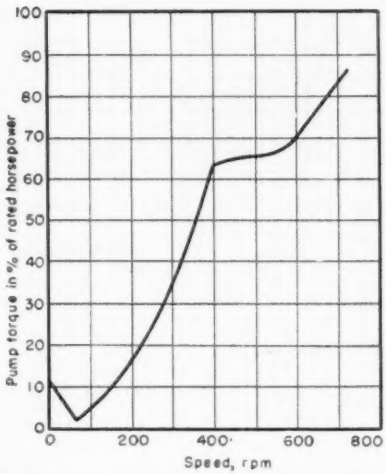
Starting the Pumps. Assume one pump is arranged to start when the suction level reaches 2 ft above minimum. If discharge-water level is at a maximum that pump would start against a 14-ft static head. With such an installation there are two possibilities: The pump might be empty above suction-water level or, if the pump had been shut down for only a short time, it might be completely filled with water.

Assuming the latter, as the impeller starts, the pump would not deliver any water until after it reached a speed at which the shutoff head exceeded the static head. The resulting torque curve would be as indicated in Fig. 6.

Had the pump been empty above the suction-water level the impeller would have immediately begun to fill the column pipe with water. Without a detailed study of the time necessary for the motor to reach various speeds, it would be difficult to predict the torque-speed curve of the pump. It would,



5 Constant-speed characteristic curves for 30-in.-discharge 700-rpm high-specific-speed axial-flow propeller pump having a shutoff hp that is about 2.5 times the rated value



6 The speed-torque curves of the 30-in. axial-flow propeller pump in Fig. 5 when it is started with the column pipe full of water against a check valve in the discharge line

however, have torque values below those in Fig. 6. Of all the centrifugal pumps, high-speed axial-flow designs, even when started against a check or flap valve, have the most adverse starting torque characteristics. But they offer no problem for the usual drive.

Vertical Turbine Pumps. Usually vertical turbine pumps for deepwells and open-pit high-head installations have mixed-flow impellers and several stages. Some designs have shutoff horsepowers lower than rated capacity, while a few have shutoff horsepowers greater than required at rated capacity.

Many installations have cone stop valves that serve as a combined check-and-gate valve. For practically all motor-driven pumps, the time required is very short for the motor to bring the unit to full speed after the shutoff head equals the head on the discharge side of the valve. Travel of the valve is so small during this interval that the starting of the unit is, in effect, the same as against a closed gate valve.

This effect can occur with other slow-opening check valves. In such installations, however, it is best practice to select and analyze the starting cycle as for an instantaneously opening check valve, with no inertia effect in the hydraulic system. Systems that have propeller pumps should use quick-opening check or flap valves or have a siphon discharge.

Torque Characteristics. Centrifugal pumps require a low torque to start from rest and the driving torque does not reach maximum until at full rated speed. Therefore, applications are seldom found where starting-torque characteristics of a centrifugal pump must be taken into account. These characteristics must be considered where: (1) size and length of the power line supplying the pump motor make a detailed study necessary to select the proper motor and control (2) synchronous motors are to be used and the motor's pull-in torque has to be compared with that required by the pump.

Starting torque of a synchronous motor depends on a squirrel-cage winding in the pole faces. This winding is designed to bring the motor and its connected load up to about 95% rated speed before closing the field-excitation switch, when the motor's rotor pulls into step. So pull-in torque that a synchronous motor driving a pump must develop is that needed by the pump at 95% speed.

Exhaust Steam Stops Corrosion

OUR PLANT formerly generated power. During much of the year, surplus exhaust steam went to waste. Our coffee urns, steam tables and other kitchen equipment were supplied 30-psi steam through a reducing valve. We also had a steam-driven vacuum pump, pulling condensate from our hot-water heaters. As an experiment, I piped exhaust steam from this pump to the 30-psi line.

We found the exhaust from the pump was only a little less than that required in the service lines, the balance coming through the reducing valve. Coal saved was nearly equal to that required to drive the pump.

When we stopped generating power, we did not have surplus of exhaust steam, so we no longer saved coal by using the pump's exhaust in service lines. But we continued doing so, because we found the exhaust helped to prevent corrosion in these lines. Before using pump exhaust in the service lines, we often had to renew sections of the condensate return piping. Frequently, these sections were under low shelves where it was hard to work with a pipe wrench.

When we used the pump exhaust in the lines, the slight amount of oil in the steam put a thin film on the inside of the pipes. In four years, since we made the change, we have not had to renew a piece of pipe.

Our 2-psi heating-system return lines have never shown signs of corrosion. Apparently this is also because of the presence of oil, as the system receives the exhaust from other pumps. The separating action of our feedwater heater has prevented oil from getting in our boilers.

ARTHUR HOLT *Atlantic City, N. J.*

LIME-SLURRY SURFACE . . .

1 Lime slurry made up of city water and hydrated lime serves as base material for application on boiler metal surfaces

. . . REDUCES SLAG GROWTH

2 Slurry is mixed to a consistency that can pass through a commercial spray gun; then it is sprayed over the surface

Can Slag Deposits Be Prevented?

Here's a pro-and-con discussion on how slag forms, its possible controls and preventive methods. It's touched off by a report* on what one utility finds workable for boiler units

► BACK IN JANUARY 1941, the Narragansett Electric Co, Providence, R.I., put a 1215-psi 920-F 430,000-lb-per-hr steam generator on the line. Its first year of service produced no operating problems of any consequence.

In the second year, however, slag conditions in the superheater made a serious operating problem. Frequent hand lancing proved the only way to hold proper draft for normal load. Because the superheater could never be thoroughly cleaned during operation, gas-pressure drop across it kept increasing. At last, regulation of final steam temperature with a bypass damper control became an extemely difficult job.

When the boiler came off the line for overhauling the superheater was mechanically cleaned. After about two months back in operation, superheater fouling again proved serious and continued to be for the remainder of the on-line boiler service.

This experience is in no way unique. For the past eight years or so boilers going into service have been plagued by such an experience. For a period of time, when brand new, no slag accumulates on their surfaces. Then deposits on superheater and economizer sections appear and become more troublesome with time.

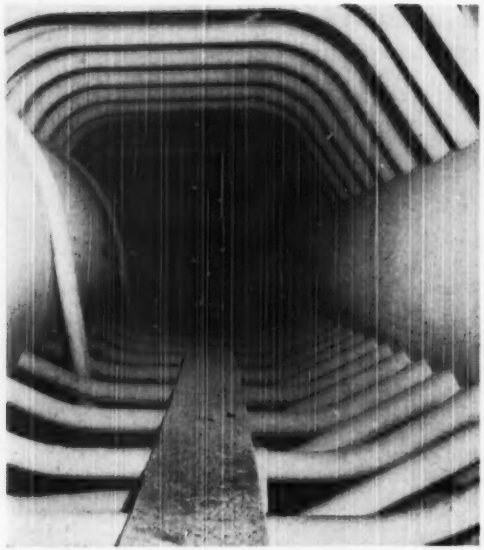
As operating pressures and total steam temperatures climb higher, still another type of scale or slag builds up in the cooler passes of the boiler. The accumulation can't be removed without pulling the boiler out of service.

Slag Causes. What's behind all the trouble? Engineers here and abroad (POWER, May 1948, p 73) have studied the problem. Their findings indicate two rough slag-accumulation divisions: (1) deposits attributed to melted ash—confined mostly to the primary and secondary furnaces where temperatures are above the melting point of ash (2) deposits formed in the lower-temperature regions at temperatures below the fusion point.

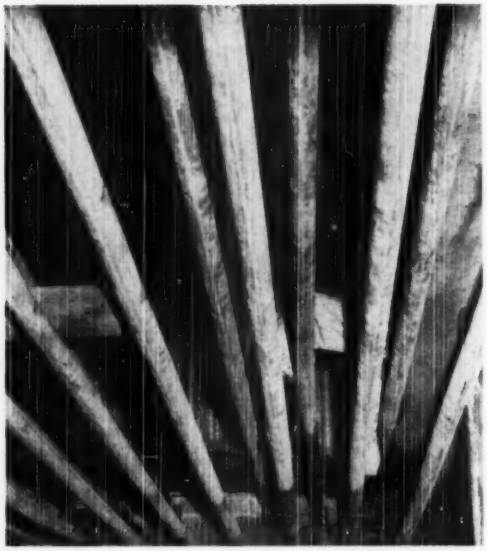
High-Temperature Slagging. In division (1), ash-fusion point and the kind and quality of constituents in the ash largely determine the slag formation. If ash particles reach the sticky or agglomerate stage while in the furnace they tend, on impingement, to adhere to tube. These particles may or may not be completely burned or the ash completely oxidized before deposition.

This point is highly important. H F Johnston at the University of Illinois reports agglomeration points of ferrous

*_Some Aspects as to the Cause and Prevention of Slag Deposits on the Heating Surfaces of Modern High Pressure Boilers_, by E F Walsh, Superintendent of Power Stations, Narragansett Electric Co before the Spring Meeting, ASME, New London, Conn. May 3, 1949.



3 Completed lime-sprayed boiler interior looks like above. Results at Narragansett Electric Co indicate slagfree year



4 When a unit comes off the line, water from a hot-process softener is sprayed over slag until the binder dissolves

sulphide, FeS, at 860F; ferric disulphide, FeS_2, at 840 F; ferrous oxide, FeO, at 1065 F; calcium oxide, CaO, 2100 F; a mixture of 92% ferric oxide, Fe_2O_3; and 80% calcium oxide, CaO, 869 F. These points indicate, if pyrite is present in the original ash, it influences the agglomeration point of that ash until it is completely oxidized—in other words, until all sulphur in the ash burns to SO_2 or SO_3, and the iron to Fe_2O_3.

Johnston's findings make it apparent that calcium oxide acts as a flux to lower the softening point of any possible Fe_2O_3, CaO mixture. Sodium and potassium oxides may conceivably act in the same way.

Low-Temperature Deposits. But the superheater, economizer and air preheater are in a region where gas temperature is below the fusion temperature of the ash. Therefore, some chemical attack on the metal surface must be assumed to cause scale formation and produce the environment for deposits in this low-temperature region.

In looking for the cause it is natural to try to correlate constituents in the original ash with those in the flue gas. So sulphur in the ash receives considerable attention. Let's see what happens to it.

All the sulphur changes to sulphur dioxide, SO_2, during combustion and to sulphur trioxide, SO_3, if conditions permit. Either SO_2 or SO_3 in the presence of moisture is highly corrosive, SO_3 particularly so. Sulphuric acid then forms. Since the acid is hygroscopic it raises the dewpoint of the flue gas. And a corrosion cycle is under way.

How can SO_2 change to SO_3? Most observers feel a catalyst is present in the boiler metal that accelerates the oxidation of SO_2 into SO_3. Just what the catalyst is seems open to question. Some —Johnston of the University of Illinois, Rylands and Jenkinson of England, Ralston and Seaver, also of England, and others—believe ferric sulphate causes the action. Still others, principally Harlow of England, think ferric oxide acts as the catalyst.

How does this explain the stalagmitelike growth of scale formations? Rylands and Jenkinson explain this by the presence of aluminum sulphate. They studied numerous slag formations and found certain common constituents —free sulphuric acid, alumina in various forms, ferric and aluminum sulphate.

They reason that sulphuric acid develops first and settles on the tube surface. The acid raises the dewpoint of the flue gas, and flyash sticks to the tube. The concentrated acid attacks aluminum in the ash to form aluminum sulphate. Aluminum sulphate loses its water of crystallization and goes into an agglomerate state. Over-all result is to accelerate scale and slag formations to a stalagmitelike growth pattern.

Rylands and Jenkinson had observed a period of "immunity" with new boiler installations of six to twelve months. Harlow ran a number of tests on various surfaces to see how they reacted under simulated boiler-operating conditions. His conclusions were:

1. A rusted surface is exceptionally active, whereas a clean or black oxidized surface is without effect until corrosion occurs.

2. Small quantities of lime and soda have a temporary inhibiting effect; with soda it persists for an extended period. Protection is greater if applied to an initially cleaned surface.

3. New boilers, unless rusted, do not exhibit any appreciable catalytic activity.

4. The compact black-oxide coating, which some tubes receive in the course of manufacture, appears to be highly protective, and endures for some time. But black oxidizing, merely by heating without the drawing process, has only a very temporary effect.

5. Use of alloy steels does not avoid the catalytic effect. The greater resistance to corrosion by these steels as compared to mild steel may reduce catalytic effect over a long period but it has not been definitely established.

Narragansett Experience. With these studies as a background Narragansett Electric Co decided at the 1946 annual boiler overhaul to put its slag deposits

SAMPLE ANALYSES OF SLAG ACCUMULATIONS

TABLE I

	Percent
Silica, SiO_2	5.4
Iron and aluminum, FeO_3, Al_2O_3	28.2
Sulphate, SO_3	33.2
Calcium oxide, CaO	6.0
Magnesium oxide, MgO	2.8
Ignition loss	1.2

TABLE II

	Percent
Silica, SiO_2	19.8
Iron and aluminum, Fe_2O_3, Al_2O_3	58.9
Sulphate, SO_3	6.1
Calcium oxide, CaO	1.5
Magnesium oxide, MgO	3.0
Ignition loss	Trace

TABLE III

	Percent
Silica, SiO_2	0.9
Iron and aluminum, Fe_2O_3, Al_2O_3	44.7
Sulphate, SO_3	55.6

through tests. Accordingly, under the supervision of E F Walsh, assistant supt of power plants, the company had them analyzed and found two distinct layers: (1) inner layer adjacent to the tubes resulting from pulverized fuel and oil firing (2) outer layer laid down during a period when oil was fired.

Inner layer, Table I, was reddish, 51.5% soluble in water with an initial deformation temperature of 1900 F. Outer layer, Table II, consisted of a hard, black, crystalline material 17.1% soluble in water. Its initial deformation temperature was 2150 F.

A sample of the deposit, Table III, in the gas flues between air preheaters and induced-draft fans also underwent analysis. After igniting the deposit to a red heat it burned red in color because of the high iron content. Upon cooling and standing at room temperature in a humid atmosphere it became pasty and very sticky. This was because of anhydrous sulphuric acid in the deposit absorbing moisture.

Since new boilers enjoyed an apparent immunity from slag troubles during the first year, why not protect the metal surfaces with some kind of coating? Laboratory experiments, above, had indicated lime acted as an inhibiting agent. So why not try it?

Preventive Methods. During the annual 1947 overhaul the boiler gas surfaces were thoroughly cleaned, and the method evolved, Fig. 1-3, by E F Walsh is essentially the one used today. Soft water from a hot-process softener, with a pH of not less than 11.0 and a PO_4 content of not less than 10.0 ppm, sprays over the boiler surfaces. This spray period lasts for at least 8 hr. (When possible the spray is continued for longer periods because it makes the follow-up mechanical cleaning easier.

Slag absorbs the spray water which, in turn, dissolves the binder and makes mechanical cleaning relatively easy. After all slag is removed down to the metal an alkaline water solution is applied. This wash is extremely important. The job it performs is one of neutralizing all acid in the pores of the metal.

Induced-draft fans, air preheaters and duct work receive the same treatment.

A lime slurry, made up of a mixture of city water and hydrated lime, is prepared, Fig. 1. The mixture's consistency is such that it can be passed through a commercial-paint spray gun, Fig. 2. And then all metal surfaces are thoroughly coated, Fig. 3.

The first boiler treated this way went on the line for a year without any appreciable deposits building up. No slag difficulties developed and no acid paste showed up on duct work.

In addition to this lime coating of metal surfaces, hydrated lime is added on the coal conveyor belt, 50 lb to 400 tons of coal. To date there is no evidence that addition of lime to the coal produces any marked effect on slag formations. (See "Detroit Edison Experiments," below.)

Other Plants' Experiences. What reports are there from other companies? J B Romer and R K Allen, Babcock & Wilcox Co, in discussing E F Walsh's paper (see footnote on p 91), cited their experience with lime washing against only mechanical cleaning of slag-encrusted superheaters. With mechanical cleaning only, slag difficulties reappear within four to six weeks. Thorough washing, though, extends this slag-free period to three to 12 months.

These men further reported that their experience indicated superheater slagging difficulties are not serious where steam temperature remains below 750 F, or gas temperature below 1600 F. In view of this fact, they wide-space superheater tubes in temperature zones above 1600 F. They have evidence, as yet inconclusive, that this precaution should be carried to still lower temperature zones.

On a 300,000-lb-per-hr 910-F 860-psi oil-fired unit, Romer and Allen found water lancing of superheater areas with hand lances or retractable soot blowers permitted continuous operation for several months without change in draft loss or efficiency. They believe vanadium along with sulphur in the fuel oil causes most of the troublesome deposits.

Detroit Edison Experiments. Before Detroit Edison heard of the Narragansett Electric Co's experiments they had injected one bag of lime per hr directly over the fuel bed of a large single-ended underfeed stoker-fired boiler with an extended grate surface of 611 sq ft.

Draft losses proved so great after 21 days' operation that the unit had to be shut down and cleaned. Normally this boiler ran 30 to 40 days.

Their next development, as reported by P Murphy, Jr, boiler-room engineer, was to clean all heating surface by washing with a solution of hot trisodium phosphate. The solution ran 640 ppm of trisodium phosphate; pH of 11.5; temperature, 170 F. This solution was sprayed over heating surfaces for 16 to 32 hr, and the surfaces then tested for acidity.

Results were excellent. But because Detroit did not get down to bare metal, except for about 25 to 30% of the surface, by the washing process alone, they went to sandblasting waterwall, boiler and as much of the superheater tubes as possible. The wash process followed this up to neutralize any acid condition present on the heating surfaces.

After this preparation they limed all surfaces. Slagging of the superheater and build-up of deposits seemed retarded for four to five days. After that they accumulated at about the usual rate.

Nature of Slag. W T Reid, supervisor, fuels research, Battelle Memorial Institute, expressed the feeling that the material, Table I, was definitely not coal-ash slag. The large amount of sulphur present as sulphate, the small amount of silica, and the fact that more than half the deposit was water soluble show this material is quite unlike the original coal ash.

If it is assumed that the roughly 23% not accounted for in Table I is sodium and potassium oxides, the deposit is like those found in wastage areas.* Here loss of metal externally from the tube is the apparent source of iron compounds in the deposit. Reid felt it would be interesting to know if the superheater elements, Table I, were gaged to determine if any thinning had occurred.

Sulphur trioxide, Reid agreed, in the presence of alkalies is the agent responsible for deposits melting below 1800 F. But at least as far as the superheater goes, he felt lime acted as a neutralizer rather than as a preventive of catalytic conversion of sulphur dioxide to sulphur trioxide.

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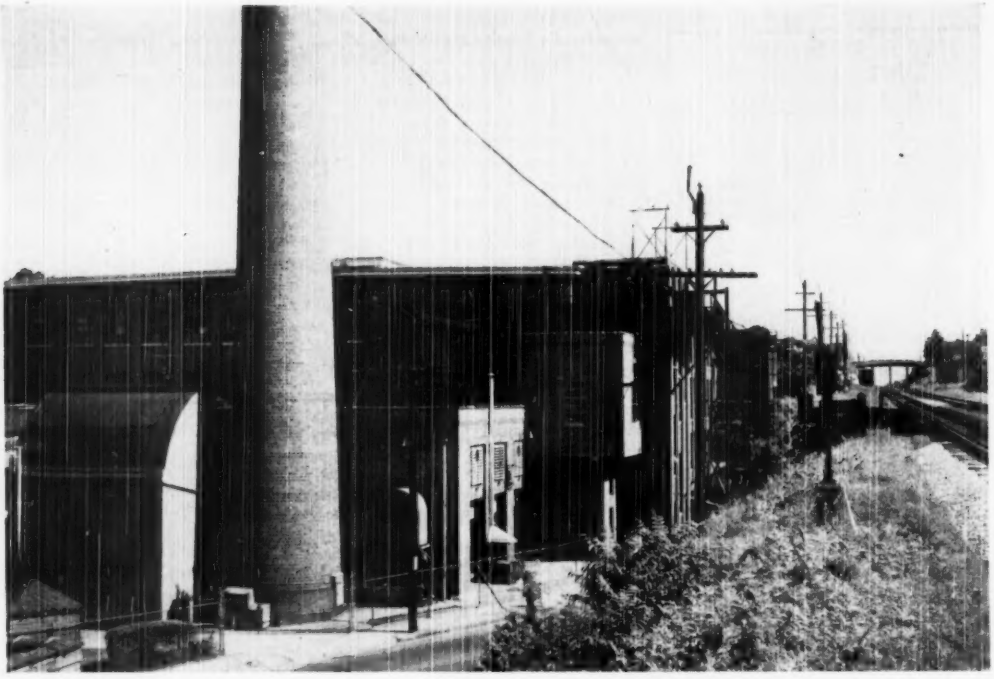
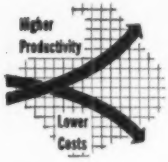
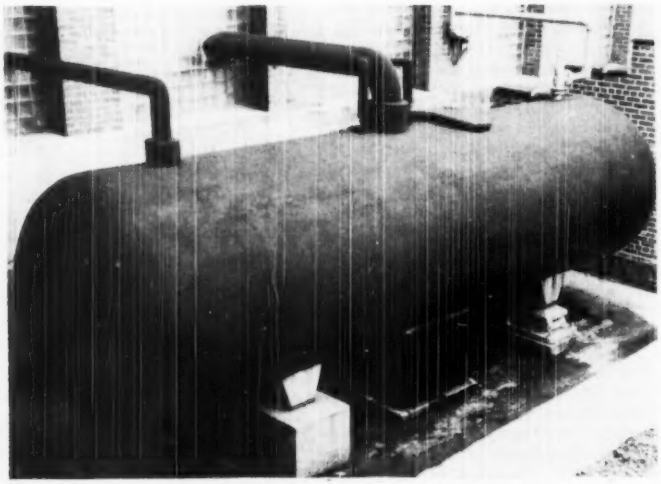
* *External Corrosion of Furnace Wall Tubes—I: History and Occurrence*: W T Reid, R C Corey, B J Cross. *Transactions of ASME*, Vol 67, 1945 pp 279-288.



1 When introduction of nylon changed production techniques at Hanes Hosiery Mills, steam demand increased, with high short-duration peaks. An accumulator permits meeting all demands without installing excessive boiler capacity for peaks



Accumulator Plus Controls

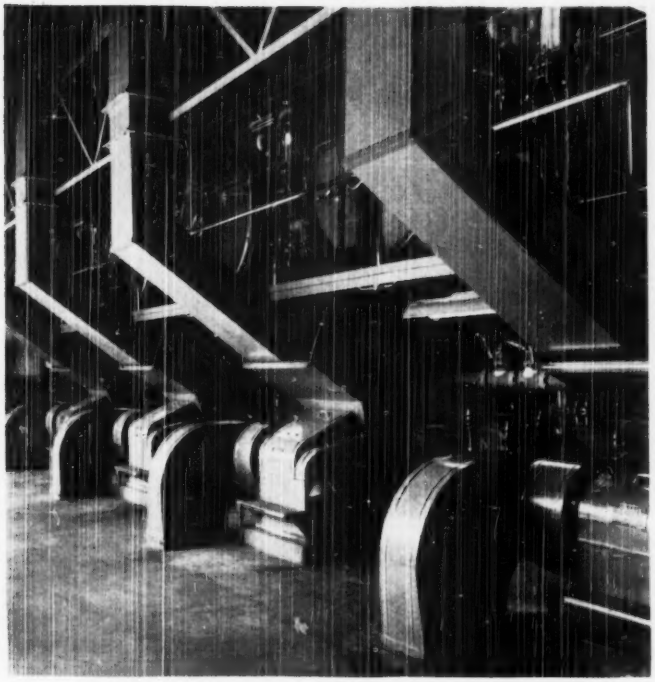


3 Accumulator, 6 ft in diameter by 24 ft, operates 50% full, holds 340 cu ft of water in storage under 45-psi pressure, can supply 35,000 lb per hr for 10 sec

Use of nylon yarn in hosiery adds to mill's steam demand, causes heavy and short-lived peaks. Accumulator floats on the line, without a pressure-reducing valve for steam-flow control to process, permits solving problem economically

By H K STREMMEL Jr
Lockwood Greene Engineers, Inc.

NORMALLY, BOILER CAPACITY depends on expected peak steam demand. But when that peak holds for only a few seconds out of every two minutes during plant working hours,



2 A change from hand firing to stokers, plus an extra boiler unit, brought steam capacity to 45,000 lb per hr. With accumulator, this handles 72,000-lb peaks

Evens Out Steam Peaks

ordinary rules don't hold. Faced with just such a problem, Hanes Hosiery Mills Co, Winston-Salem, N. C., with Lockwood Greene Engineers, Inc, solved it by putting in a closely controlled steam accumulator. Here's the way the problem developed and how the solution was worked out.

An abrupt change in production methods came about when nylon yarn made its bow in the hosiery field. Nylon, a plastic, has to "set" in a controlled atmosphere of heat and moisture. Temperature must lie well above boiling point of water. This is known as *preboarding*.

The Problem. Hanes engaged Lockwood Greene in the late fall of 1913 to design a building to house nylon preboarding machines. This included estimating future plant steam demand based on manufacture of nylon stockings and recommending the best way of meeting this demand. The preboarding process was then new and its requirements for steam not fully known. Determining the steam demand of these machines thus formed the first and biggest part of the job.

Preboarding Cycle. The preboarding machine is in essence an autoclave in which the nylon stockings are "cured" by steam under controlled conditions of time, temperature and pressure. Operating cycle consists of loading the machine, turning on the steam, holding pressure and temperature conditions for the desired time, and then exhausting and unloading the machine.

Steam Demand. In the design of steam-distributing piping to the preboarding machines, it is necessary to consider instantaneous steam demand, average steam flows, and the hourly steam use of the machines. The problem is further complicated by the fact that the machines may or may not be started together and the steam-distributing piping is low pressure.

Average steam use for all the machines was 7200 lb per hr, based on test data. This is the boiler load. The instantaneous flow that occurs the instant the steam valve is opened is figured out at the rate of 86,400 lb per hr if all machines are started together. Under this condition, the average line flow during the first 10 seconds is 72,000 lb per hr, whereas the average line flow for the rest of the cycle is only 3900 lb per hr.

Examining these figures critically, we can see that it's inconceivable that all machines, with different operators, could all get under way within one second even if started on a signal. This means we can disregard the one-second instantaneous flow. The 10-sec average of 72,000 lb per hr is more in line.

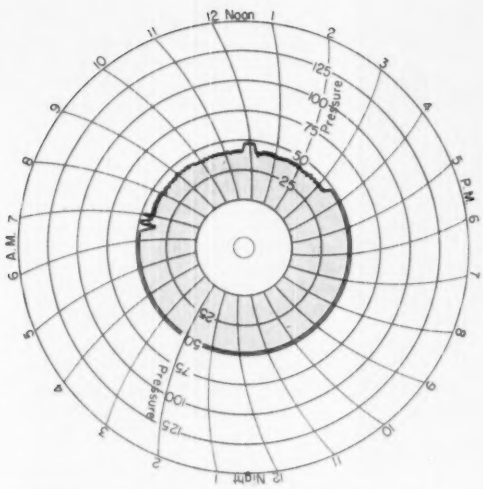
At end of first cycle, machines may be as much as 10-15 sec apart. Except for morning and noon starting cycles, it is unlikely that more than half of the 40 will start within a 2-sec period. In fact, it is more probable that no more than ten start as close together as two seconds. This brings maximum flow down to around 43,000 lb per hr, and allows designing much more economical piping. All we need is a slightly longer cycle time for morning and noon startup periods.

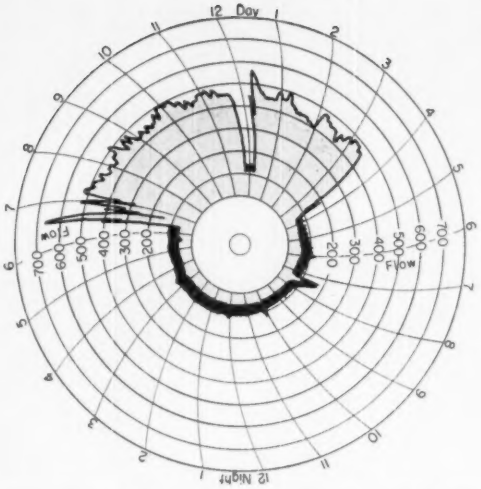
Supply Pressure. When machines were tested for steam consumption, various line pressures were tried. About 35 psig gave satisfactory cycles. Thus line pressure was set at 40-45 psig, allowing 5-10 psig pressure drop at maximum flow. Higher pressure could be used but it would mean additional safety valves to protect machines.

For the chosen machine layout, with a limiting pressure drop of one psi per 100 ft, pipe size figured to 6 in. for 40 psig. With higher pressure, 4-in. pipe could be used, with increased pressure drop. Since difference in cost would be small, 6-in. pipe was considered more desirable with lower operating pressure.

Steam-Flow Control. Now let's turn to another problem—steam-flow and pressure control. How does one control an instantaneous flow of 72,000 lb per hr, a normal maximum of 40-50,000 and an average of 7200, and still have a dead-end shutoff when machines stop?

Let's consider an 8-in. single-seated reducing valve. That would pass the instantaneous flow of 72,000 lb per hr, reducing from 130 at mains to 45 psig for machines. But severe service under wide load range would wiredraw the seat. With leakage of only 3%, there would be a flow of about 2000 lb per hr. This would cause distribution piping pressure to vary from 40 to 130 psig every cycle. A number of smaller valves might prove better but total capacity would be the same and even 1% leakage would be excessive. Pres-





4 Chart above shows steam pressure on the lines running from the accumulator to all nylon preboarding machines. Chart on the right pictures the fluctuating steam demand whose sudden swings in load are taken by the accumulator

sure-reducing valves thus do not seem the answer for this condition.

Another possibility lies in lowering boiler pressure to 40-50 psig. Pipe sizes would have to be increased from boiler to preboarding room and perhaps to other parts of the plant. The owners also decided that 80 psi was minimum allowable dyehouse pressure.

Accumulator Chosen. Best solution seemed to be an accumulator. Space was available in an areaway just outside the conditioning room, about 50 ft from the preboarding room.

Most accumulators store as much energy as possible when boiler demand is low and release it when steam demand is high. Thus, usual accumulator operates 90% full at boiler pressure when fully charged.

The Ruths accumulator at Hanes Hosiery, designed and built by Foster Wheeler Corp, Fig. 3, differs markedly from the usual. The accumulator floats on the line. No pressure-reducing valve controls steam flow from accumulator to process. As the machines draw steam and cause a pressure drop, water in accumulator flashes, releasing additional steam to process. Boilers feed 130-psig steam to the accumulator at an essentially constant rate which approaches average steam demand. Accumulator will release steam at any rate of flow up to maximum demand.

Accumulator Design. Two considerations govern accumulator design: (1) water volume must be enough to store needed steam between pressure limits, and (2) surface area must be enough to release steam without too much priming.

Pressure can vary from 35 to 45 psig, so we have a 10-psi drop available. Enthalpy difference in saturated water at these pressures runs 12 Btu per lb. Steam at the average pressure of 40 psig contains 1175.8 Btu per lb. Thus it takes 1175.8/12, or 98 lb of water at 45 psig, to make one lb of steam between the limits of 35 and 45 psig.

Maximum demand occurs when all machines must reach operating pressure within 15 sec. For this demand 240 lb of steam is needed. If reducing valve is passing 7200 lb per hr (2 lb per sec), it will supply 30 lb in 15 sec. Thus, accumulator must store the difference, 240 — 30, or 210 lb. Since it takes 98 lb water to make one lb of steam, we need 98 x 210, or 20,600, lb of water at 45 psig saturated. This is about 350 cu ft of water.

Steam Release. Conservative figuring allows 1800 cu ft of steam released per sq ft of surface area per hr. Thus, 210 lb at 40 psig would need 1630x 3600/15x1800, or 216 sq ft. But velocity of steam leaving water surface is only 0.5 ft per sec. For an accumulator, this can be stepped up to one ft per sec cutting surface area needed to 108 sq ft.

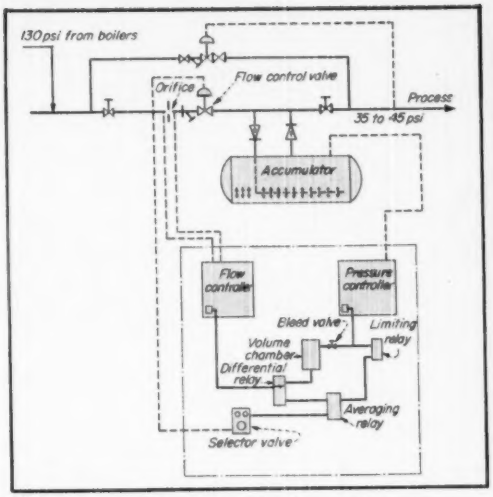
A vessel 6 ft in diameter and 24 ft long, operating 50% full, would give about 340 cu ft of storage space and 144 sq ft of surface. This seemed like a good compromise and the vessel was ordered on this basis. It is designed for 150-psig operation, with safeties set at 140. Thus accumulator can be operated at boiler pressure if preboarding process should ever change, or if some other service is desired.

Accumulator Control. To avoid problems growing out of the human element, an automatic control was selected, requiring only a preliminary steam-flow-rate setting. This system maintains: (1) constant flow rate from boilers to process (2) process-steam pressure within limits for best operation, and (3) maximum process-steam pressure below machine design pressure.

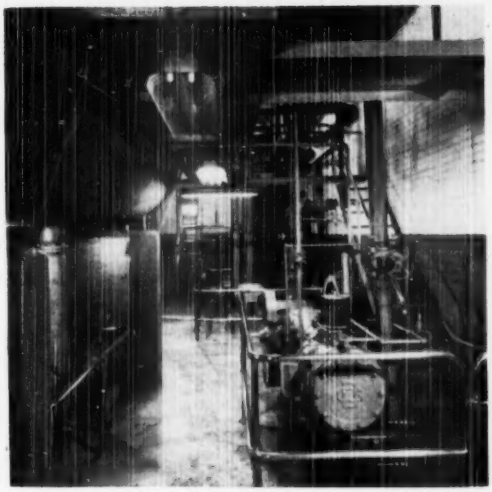
Fig. 5 shows the 2-element Bailey Meter Co control scheme. Steam-pressure and flow controllers are calibrated to produce a predetermined steam-flow rate for any given average accumulator pressure. Average pressure indicates how near steam flow is to process use. Maximum and minimum pressures depend on whether preboarding machines are in synchronism.

Steam-flow controller and pressure controller connect through a differential standatrol relay, an averaging relay and a hand-automatic selector valve to the flow-control valve.

Bleed valve and air volume chamber between pressure controller and differential standatrol relay average out accumulator-cycle pressure fluctuations. With flow-controller air-loading pressure matched against pressure-controller volume-chamber air-loading pressure, a relatively constant rate of flow from boilers to process results.



5 Control system has been designed to maintain nearly constant steam flow from boiler; stable pressure for process



6 New pump room has condensate surge tank, booster pumps, 5-psi deaerating feedwater heater, and feed pumps

The limiting standatrol relay measures actual accumulator pressure. When it reaches a preset value, limiting relay acts through averaging relay to shut flow-control valve. This prevents process pressure exceeding permissible machine pressure.

A control panel in the preboarding room permits the foreman to set the standard pens of the two controllers at (1) desired steam flow for number of machines scheduled (2) required average accumulator pressure.

Accumulator Performance. The accumulator was put on the line in April 1948. All preboarding machines had been operating on a 4-in. reducing valve with pressure to the machines fluctuating from 25 to 40 psig. It had been found necessary to stagger machine operation as much as possible to prevent wider swings than this. With accumulator in parallel with reducing valve, all apparent pressure fluctuations ceased. Reducing station was then shut off and accumulator pressure varied between 41 and 42 psig.

The lunch hour had been staggered and machines were started up a few at a time after lunch to prevent excessive pressure swings on the reducing valve. As a test, we decided to start ten machines in synchronism at 12:15 pm and, if successful, 20 machines at 12:30 pm. On the first test, accumulator pressure dropped from the shutoff point, 48 psig, to 42 psig, normal pressure. On the second test, accumulator pressure dropped to 36 psig in about 15 sec. This change of 6 psi represented an accumulator discharge of 145 lb of steam. Adding the flow through the control valve, about 12 lb, this is an average line flow of 38,000 lb per hr. Water-level fluctuation in this last test indicated we were approaching the discharge limit but there was no apparent carryover of water into the steam line.

The accumulator has now seen over a year's service, without operating difficulties and with minimum attention and maintenance. Staggered operations have been cut out.

Plant Changes. To meet steam needs of additional dyeing capacity and ventilation, plus the preboarding machines, installation of forced-draft underfeed stokers on three existing 1500-sq-ft hrt boilers was recommended. When plant steam-demand figures were revised on the basis of final design of the preboarding installation, a fourth hrt boiler was recommended. At 150% rating, the four hrt's would carry the estimated peak of 45,000 lb per hr. During normal operation, one boiler would serve as a spare.

Room was made for the additional boiler by moving feedwater equipment out of the boiler house. A pump room was built on the other side of the wall. Fig. 6. Into it went a new horizontal condensate surge tank, booster pumps, a 5-psi deaerating heater and centrifugal feed pumps.

Low-Cost Producer Gas From Bituminous Coal

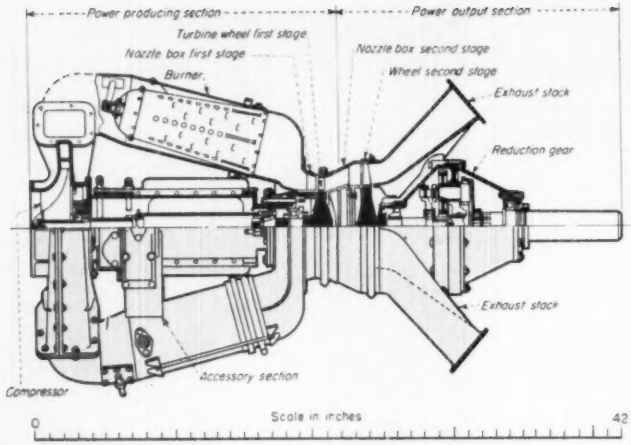
► SINCE OIL AND GAS quantities are limited, compared with coal, many industries in addition to the coal industry look to fundamental research to uncover coal as a gas and oil source.

Even today in what is felt to be an undeveloped stage the conventional gas producer is still the cheapest way of converting coal to a gaseous fuel. Right now the gas produced cannot compete with natural gas, as an example, although some areas might find it valuable as a standby.

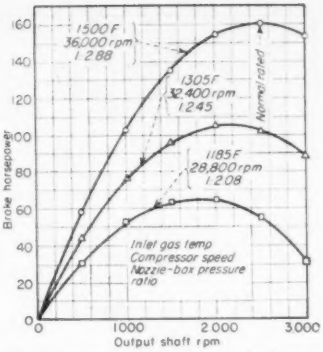
Gas producer of today has little output for its size and cost. It requires selected coals; then gives out a raw gas containing tars and solids. They might be acceptable for a luminous flame but they are nuisances in internal combustion engines.

Bituminous Coal Research, with Battelle Memorial Institute, Diesel Engine Mfrs Assn, and Glass Containers Mfrs Institute, has begun research.

John Mitchell, Director of Research, Eastern Gas & Fuel Associates, National Coal Assn Convention, New York, Oct 7, 1949.



1 First-stage single-wheel turbine drives single-stage centrifugal compressor supplying air to two can-type combustors. Second-stage turbine drives the load

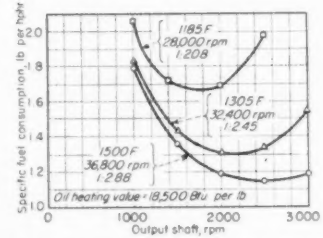


2 Power output depends on both gas-producer, load-driving turbine speeds

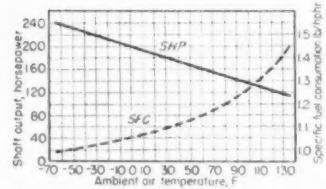
160-Hp Gas-Turbine Unit Will Do Many Chores

Here's predicted performance and application of small gas turbine that develops 160 hp with 1500-F inlet gas. Compactness, portability, light weight make the engine versatile over-all performer for power-generation jobs

By J C ANDERSON, *Boeing Airplane Co*



4 Maximum thermal efficiency occurs at max output with 1500-F inlet gas


SHP
SFC
Shaft output, horsepower
Specific fuel consumption lb/hphr
Ambient air temperature, F
-70 -50 -30 -10 0 10 30 50 70 90 110 130

5 Both capacity and thermal efficiency decrease with rising air temperature

► As part of a general research program the Boeing Airplane Co built and tested two small gas turbines in early 1947. They are in the 150- to 200-hp capacity range. The 500 is a jet engine, and the 502 a shaft engine. Since 1947 the Bureau of Ships, U. S. Navy, has guided the development of the 502.

This model, rated at 160 hp with 1500-F inlet gas to turbine, weighs 200 lb. Laboratory testing to date indicates the engine will soon compete with other prime movers from the reliability and service-life aspects. Simultaneously with continued developing and application testing, Boeing is attacking the manifold problems of manufacture and distribution that must be solved before placing the engine on the market.

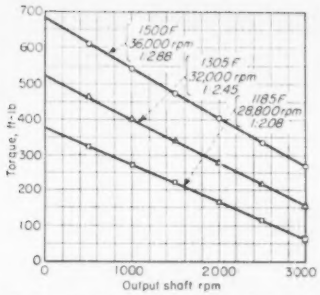
Some of the most promising applications occur in the industrial field where portability, low volume and quick starting are needed.

The Unit. A gas-producer section and a power-output section, Fig. 1, make up the gas-turbine unit (see Power, April 1949, p 117). The gas producer (equivalent to a boiler) is actually the Model 500 jet engine. It consists of a single-stage centrifugal compressor, two can-type burners, an axial-flow turbine wheel, accessory-drive gearbox, oil pump and oil sump.

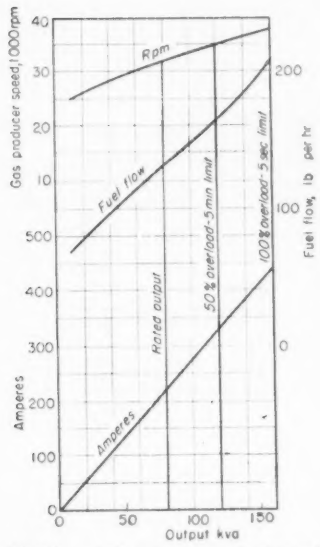
The impeller develops a 3:1 compression ratio with a mass flow of 3.2 lb per sec at a rated speed of 36,000 rpm. Compressed air flows to the burners through two tangential outlets with vaned elbows. Fuel mixes with the air in the burner and ignites. The hot pressurized gas then flows through a nozzle box and the first-stage wheel. This wheel absorbs enough energy from the gas to drive the impeller mounted on the same shaft. A spur gear keyed to this shaft drives the oil pump in the bottom of the gas-producer housing and the accessory-drive gearbox on top of the housing.

The accessory gearbox has three drive pads for (1) fuel pump and governor (2) starter-generator (3) tachometer. The oil pump is a combination pressure-scavenge gear pump. All bearings are pressure lubricated, and the oil system is an integral wet-sump system.

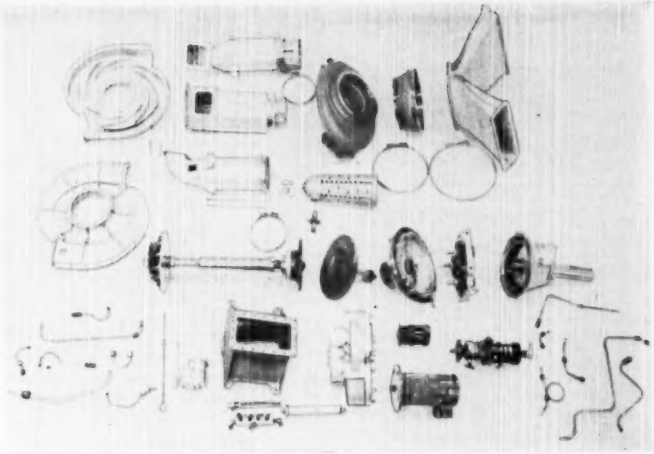
At rated speed the gas producer de-



3 Torque developed by gas-turbine unit reaches maximum at zero load speed



6 When driving alternators load speed stays constant, producer speed varies



7 Disassembled parts of complete gas-turbine unit show relatively few elements that contribute to its light weight and portability. Note small rotor wheels

velops 165-lb thrust and 225 gas hp. To convert this to shaft hp the gas flows through a second nozzle box and a second single-stage wheel that drives the output shaft. This combination makes up the Model 502 engine. At rated gas-producer speed of 36,000 rpm the output turbine turns at 22,500 rpm, and through a 9:1 reducing gear turns the load shaft at 2500 rpm to develop 160 hp continuously.

Fig. 2, 3 and 4 show power, torque and specific fuel consumption performance for the complete unit.

Starting. Three starting systems have been successfully used (1) air (2) electric (3) cartridge. Starting cycle takes about 10 sec. The starter developing about 1¼ hp accelerates the gas producer from zero to about 5000 rpm when ignition takes place. After ignition the starter continues to accelerate the shaft till idling speed of 10,000 rpm. The gas producer can then reach full rated speed of 36,000 rpm in 2½ sec.

For air starting, the compressed air flows through the first turbine wheel from a nozzle mounted in the first-stage nozzle box. About 30 cu ft of free air is used per start.

Electric starting energy comes from a 12- or 24-v starter-generator. It has a 30-amp generating capacity. Because of the free-wheeling characteristic the gas-turbine unit can be started while it is connected to the load.

Cold Weather. Most of the starter energy goes to bring the compressor up to speed. The slight friction to overcome is that of the two bearings on the gas-producer rotor and the accessory bearings. This causes starter-power requirements to remain comparatively constant even in sub-zero weather.

During starts the power-output wheel remains stationary, absorbing no energy. In cold weather the exhaust gas can be used to warm up the power output section quickly. In sub-zero weather the unit is expected to be started, warmed up and have its fuel feed opened up to rated power in 60 sec.

Fig. 5 shows the effect of ambient temperature on power and specific fuel consumption. As temperature decreases, thermal efficiency and output increases. Exhaust heat of about 2,500,000 Btu per hr can be used for space heating or to warm equipment during cold weather.

Tropical Operation. Decreasing thermal efficiency with increasing temperature is offset by the fact that the unit is easy to cool. Oil-heat rejection equals about 200 Btu per min. In some units an oil cooler will be needed. Other than this, normal air circulation around the engine can handle its cooling. Neither water nor a forced-draft air-cooling system is needed.

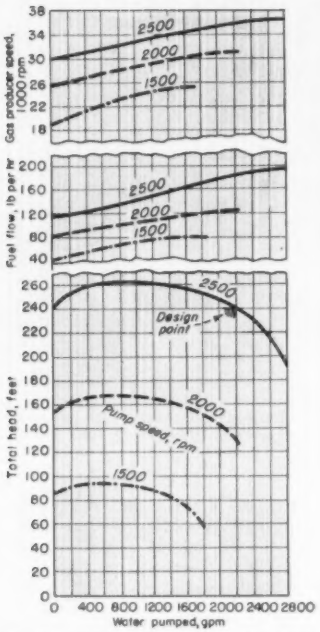
Fuel. Unit operates equally well on low-octane or high-octane gasoline, diesel oil and kerosene. With little additional development it can be made to operate on gas and bunker-C oil, as well.

Thermal efficiency compared to other prime movers is low. In some applications it is possible to increase thermal efficiency with regenerators and compression intercooling. This complicates the engine and increases weight and bulk. The most promising approach to increased efficiency without complexity is by raising the turbine and the compressor adiabatic efficiencies. This is a long and arduous research job. In the meantime there are applications where the disadvantage of low thermal efficiency is offset by the engine advantages.

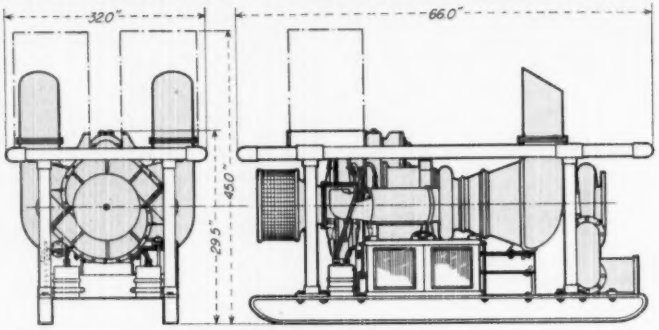
Advantages. Constant rotary motion and continuous energy flow contribute to practical elimination of any serious vibration.

Light weight and small volume simplify installation and removal. Power producing and power-output section can be disconnected by removing a chevron clamp. This permits one man to remove and install the engine without the aid of hoisting equipment. In a recent demonstration the engine was completely disassembled for inspection and then re-

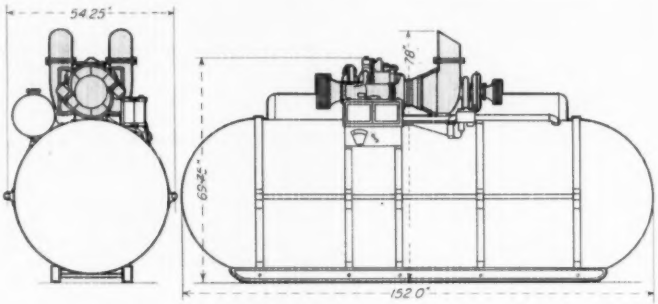
GAS-PRODUCER ELEMENT CAN DRIVE APPARATUS THROUGH THE POWER TURBINE...



8 Pump-performance curves show flexibility of gas-turbine drive, Fig. 11. Pump can produce any combination of head and flow without any throttling losses by running at optimum efficiency



9 Gas turbine driving 30-psig centrifugal compressor can be used for ventilation and conveying services requiring a large continuous supply of low-pressure air



10 To supply 120-psig compressed air, gas turbine and centrifugal compressor can be mounted on top of receiver holding a one-minute supply of compressed air

assembled. One man did this work in six hours. Total weight of the tools used was 14 pounds. No hoisting equipment or jacks were needed.

Torque. As the gas-producer and power-output sections are not mechanically connected the engine has a torque characteristic similar to a steam turbine or torque converter. The gas producer can be operated at rated speed even though the output section stalls. Under this condition output-shaft torque is twice rated torque. Note the sloping curve in Fig. 3, also the flatness of the hp curves, Fig. 2, between 2000 and 3000 output-shaft rpm.

Transmission. In many applications the 2:1 torque ratio is enough. Where a reverse gear and additional forward-speed torque is needed, the present reduction gear can be replaced by a combination transmission and reducing gear.

Since there is no torsional vibration and the cushioning effect of the gaseous power transmission absorbs shocks, the transmission can be kept within reasonable weight and volume. Preliminary layouts indicate such a transmission would increase engine weight 100 lb and engine length 10 in.

Simplicity. While every operator realizes importance of engine simplicity it is difficult to evaluate. Fig. 7 shows all engine elements laid out for assembly, demonstrating relatively few parts. This will have important effects on (1) production costs (2) maintenance needs (3) parts stock (4) shipment of parts (5) installation ease. Comparison of weight and volume for different engine types for the same 160-hp capacity follows:

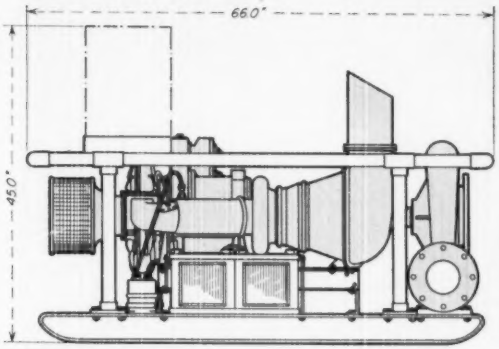
Type	*Weight, lb*	*Vol, cu ft*
Gas turbine	200	12.7
Aviation gasoline	395	25.2
Industrial, automotive gasoline	1810	46
High-speed diesel	2650	66

Applications

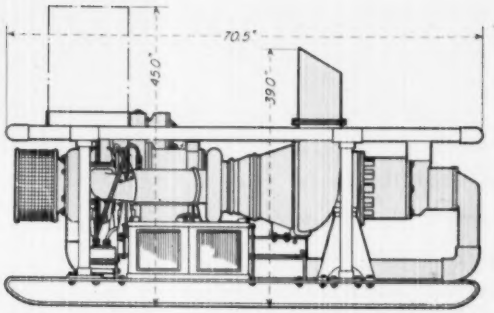
Application tests now under way will be backed up by concurrent development and laboratory work. Most suitable application of the 502 will be to power portable heaters, generators, pumps and compressors. One of the major problems will be the development of suitable driven equipment. For the most part, available equipment is too bulky and heavy. Boeing has done some preliminary design work on lightweight, compact equipment showing favorable development possibilities. It is hoped present manufacturers will be interested in developing the needed types as Boeing does not wish to enter these fields unless necessary.

The following illustrations aim at a design objective for equipment that can be quickly disassembled and assembled. is adaptable to air transportation and can be carried into inaccessible places by hand. This equipment is also suited to automatic-starting emergency equipment used for relatively short periods of time while the main power-supply equip-

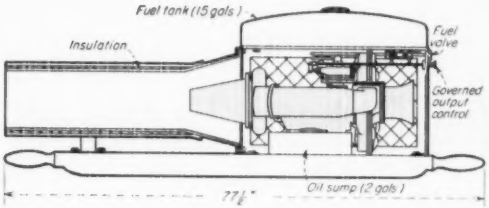
...OR IT CAN SUPPLY ENERGY FOR HEAT



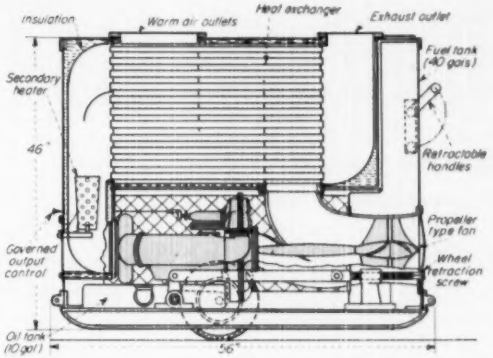
11 This water pumping unit can deliver 2175 gpm against a head of 240 ft with turbine driving the pump at 2500 rpm



12 Gas turbine can be arranged in number of ways to drive alternators at constant speed, here are two 80 kva units



13 By removing the power-turbine element and using the gas producer only a portable equipment heater can be made



14 For space heating applications the gas-producer element and secondary burner supply heat as needed to exchanger

ment is out of service for maintenance.

Generator Drive. Fig. 12 shows the gas turbine driving two 400-cycle 40-kva alternators at a speed of 6000 rpm. Fig. 6 shows the over-all performance. The rated output of 80 kva is reached at a gas-producer speed of 32,000 rpm with a total fuel flow of 131 lb per hr. A 100% overload capacity can be developed at maximum turbine rotor speed. Weight of complete unit is estimated at 494 lb.

Air Compressors. Fig. 9 and 10 show two air compressors using the gas-turbine drive. The 30-psig unit, Fig. 9, can be used for ventilation and conveying services needing a large amount of low-pressure air. It can produce about 1390-cfm free air at a compressor speed of 46,200 rpm, corresponding to a gas-producer speed of 36,000 rpm. The total unit with compressor and frame weighs about 375 lb.

The 120-psig compressor unit, Fig. 10, can be used where an intermittent h-p air flow is needed, as with pneumatic tools. It can produce about 535 cfm free air at a compressor speed of 69,300 rpm corresponding to gas-producer speed of 36,000 rpm. Total unit with receiver weighs about 742 lb.

Receiver size appears to be out of proportion to the engine, but recommended standard of providing a volume equal to that pumped in one minute by the compressor was followed. Existing commercial compressors with equivalent capacity provide a receiver about one tenth the volume. It appears reasonable to assume receiver capacity can be reduced with concurrent reduction in weight and space.

Water Pump. Fig. 11 shows the Model 502 driving a water pump. This unit can deliver 2175 gpm against a head of 240 ft with a pump speed of 2500 rpm, as shown by the performance curves, Fig. 8. With an estimated weight of 385 lb the unit is suited for portable fire-fighting equipment or for emergency water supply. Variable-speed operation helps low-load operating economy.

Heaters. Fig. 13 shows a simple portable heater unit adapted from the gas-producer section of the gas-turbine unit. It uses the jet energy in an injector to supply large quantities of air for rapid heating of mobile equipment. Heat output equals 3,600,000 Btu per hr at an outside air temperature of −80 F. The unit weighs 250 lb. The hot-air discharge from this heater contains about 0.9% CO_2 and 0.2% CO when operating at −65 F with 95% combustion efficiency.

Fig. 14 shows the gas-producer adapted for supplying large quantities of energy for space heating. Many arrangements are possible and almost any capacity can be built. The unit has a ventilating blower, secondary burners and heat exchanger to provide heated fresh air. Using the secondary burners an output of 4,650,000 Btu per hr can be developed with −80 F outside air when delivering 15 lb air per sec at an outlet temperature of 280 F. Without the auxiliary burners the output drops to 1,250,000 Btu per hr under similar operating conditions. Total unit weighs about 400 lb.

Looking far ahead from the middle of the twentieth century, Westinghouse engineers foresee 300,000-kw turbines operating at 3200 psi, 1200 F, far bigger generators, enclosed foolproof motors with built-in starters. Many other power-field advances will also give better service at lower cost. Read this high-spot summary of predictions to learn . . .

DR A C MONTEITH, with Westinghouse a quarter century and now vice-president in charge of all engineering, presided at the Mid-Century Review and Forecast Forum

What the Future Holds in

► EARLY IN 1948 Charles A Scarlott, editor of the *Westinghouse Engineer*, conceived the idea that the midpoint of this century was a logical time to pause and consider engineering progress. From this idea grew an all-day session in East Pittsburgh, in early November 1949, at which Westinghouse technical authorities presented survey papers that are appearing in complete form in the January number of the *Westinghouse Engineer*.

These surveys covered past, present and future, but our present summary considers only the future, the part that will be of greatest interest to the readers of POWER.

So here, much briefed and in our own language, are high-spot predictions from this memorable gathering—predictions dealing specifically with turbines, generators and motors. Readers interested in further details (particularly the history and present status) and in the surveys of switchgear, transformers, lighting, electronics and research should study the complete papers in the January 1950 number of the *Westinghouse Engineer*.

And for POWER's own editorial comments turn to the editorial on page 73 of this number. Briefly, we find no point of disagreement with the Westinghouse predictions, but stress the growing willingness of designers and operators to pay more for equipment that will reduce costly maintenance.

TURBINE FUTURE

D W R MORGAN
Vice-President, South Philadelphia Works

After some pause at the present 1050-F level for central-station throttle steam, the economics of rising fuel and labor costs will bring us to 1100 F. Perhaps the next step to 1150 F will follow soon, but this will require better materials than are now at hand.

How Big? Turbine-generators of 150,000 to 200,000 kw may be in demand soon. In a few years we can build single-shaft 3600-rpm units up to 150,000 kw. At 1800 rpm, a single-shaft 600,000-kw unit would be technically possible, if needed. However, using known designs, materials and near-future steam conditions, turbines larger than 150,000 kw would be cross-compounded to obtain the advantages (for the higher steam conditions) of 3600 rpm, and the ability of the 1800-rpm construction to handle the accompanying tremendous volume of exhaust steam.

Standards. The present top limit of turbine standardization, 60,000 kw, is too small for the larger systems. In the light of recent developments, standardization of a 90,000-kw machine is indicated, and preliminary consideration might be given to a 135,000-kw. standard.

If intensive research provides suitable materials, and if the economic situation justifies maximum thermal efficiency regardless of machine costs, we may some day build turbines for steam at 1200 F and the critical pressure of 3206 psia. These would produce about 8% more kilowatt hours per ton of coal than our 1050-F 2000-psi units.

The high-pressure end of such a superturbine would be the critical end. Steam might be brought to the first-stage wheels through a series of small inlet pipes feeding nozzle chambers, separately cast of some now unknown metal capable of withstanding such high pressure at high temperature. Forged parts would be out of the question because operating temperatures would already be on the heels of forging temperatures. Instead of one large diameter first stage, several small wheels might run in parallel at speeds two or three times 3600 rpm, geared to the main high-pressure element. These

MORGAN: 3200-psi 1200-F compound steam turbines in sizes up to 300,000 kw

LAFFOON: 1800-rpm generators rated up to 350,000 kva, improved insulation

LUDWIG: Wide use of compact totally enclosed motors that are "foolproof"

Turbines, Generators and Motors

small wheels, using alloys developed for gas turbines, or some improved austenitic material, could expand the steam from the 3200 psi down to 1800 psi or even lower, where it could be handled by more conventional constructions.

An alternate method would be to build high-pressure turbine stages in a separate, compact, turbine element directly coupled in tandem to the main-unit shaft.

For the 3200-psi turbine to retain the mass-flow relations of the high-pressure stages, the rating should be at least 240,000 kw, possibly more. This is desirable for leakage control and good experience.

For these extremes of 1200 F and 3200 psi, the exhaust end would not likely interfere with building a 240,000-kw unit, even at 3600 rpm. Existing exhaust blades arranged for quadruple flow could handle the steam for a 240,000-kw turbine at the assumed inlet conditions. Furthermore, we can ultimately look for exhaust blades even longer than the present 23 in. Assuming these longer blades would provide a 25% increase in exhaust annulus, a high-speed turbine with quadruple-exhaust flow could then be built for a maximum output of 300,000 kw.

Half a Million Kw. If turbines larger than 300,000 kw become economically justifiable, the most obvious way to obtain both sufficient exhaust annulus and generator capacity is to go to cross compounding with an 1800-rpm low-pressure element, whereupon a turbine delivering a half-million kw would become possible. Conceivably, then, such a gigantic unit, for 1200 F, 3200 psi, might be a cross-compound machine with multiple-flow low-pressure section, and a high-pressure element of the multicylinder type, where the first stage in tandem is geared to this 3600-rpm element.

AC GENERATORS

C M LAFFOON

Manager, Ac Generator Engineering Dept

There is need to reduce capital costs of building and auxiliary equipment and to increase the kilowatt-hours produced per manhour of operating labor. The rapid increase in capacity of individual generating systems, and the heavy power interchange connections between adjacent systems, already justifies generators of 200,000- to 225,000 kva maximum rating. This size is possible with single-unit 3600-rpm hydrogen-cooled generators at present-day construction, operating at 30-psig gas pressure.

Generators of 250,000, 350,000 Kva. With reasonable improvement in the physical characteristics of alloy forgings, and somewhat better rotor ventilation and insulating materials, it is anticipated that 3600-rpm 250,000-kva single-shaft generator units can be built as soon as needed. On the basis of the same design conditions, single-unit 1800-rpm generators can now be built for ratings of 350,000 kva, and perhaps more.

Judging by forward-looking programs now under way and contemplated, the greatest possibilities for still larger increases in ratings can be expected from new insulating materials, improved methods of ventilation, and the use of new cooling media.

Better Insulation. Generator insulation of the future will be very different from that used today. Many new synthetic insulating materials, as yet untried in windings, offer prospects for considerable improvement. Higher intrinsic dielectric strength and more uniformity will permit insulations to be worked at much higher voltage stress.

They will allow building machines of even higher operating voltages and will leave more room for copper on lower-

voltage machines. Greatly improved heat conductivity will further reduce the temperature gradient through the insulation. The copper can then carry more current without overheating. Thinner insulation means the heat can be removed more easily, with less ventilation.

This sets off a chain of economies: smaller machines, lighter foundations, smaller buildings and reduced over-all investment. In the future the primary design problem of ac generators will be to obtain a much greater output per unit weight of materials used. It is believed the generator output per pound of active material will be a third higher.

FUTURE OF MOTORS

L R LUDWIG

General Manager, Buffalo Divisions

For two decades many have been predicting the virtual disappearance of the dc motor. The prophets have been wrong; it hasn't disappeared. Far from it; dc motor sales have increased by about one half since the early twenties. Furthermore, the evidence is strong that the dc motor will continue in heavy demand for many years, not as a constant-speed motor, but to do those things for which it has no rival—deliver power where precise speed control is required over a wide range.

DC Holds Its Own. Even for this service some imagine the dc motor is waging a defensive fight. As the swing to ac distribution becomes more complete, the pressure mounts to use induction motors for work previously done by dc machines. And ways are often found for the ac motor to take over some of the dc motor's adjustable-speed functions. Yet, for every old job taken away, two more spring up that only the dc motor can handle. Furthermore, the pronounced trends in industry toward higher speeds and much more precise process control support this situation. To sum up, uses for dc motors are increasing, not decreasing.

Tomorrow's Drives. Considering all types of motors and controls, how much further improvement is possible in designs? Looking ahead, it is easy to see a continuation of some of today's marked tendencies. For example, the degree of enclosure of a motor has been steadily increasing. Today, not only are there various degrees of enclosure of the general-purpose motor, but also enclosures to make motors suitable for specific services. We have explosion-proof construction for hazardous atmospheres, the chemical motor, the lint-proof (textile) motor, the sanitary-food-industry motor, and so on.

We seem to be moving toward a single, completely enclosed, self-cooled motor that can be used for all jobs now requiring the general-purpose fan-cooled motor and for many, if not most, of the other applications now demanding special enclosures.

The motors can be run at a higher temperature as soon as available insulations will permit. The recently developed silicones may supply the answer to higher temperature insulations. Just the same, a hot motor has other disadvantages in bearings and personal hazard. So some way must be found to keep the frame fairly cool, even though the electrical parts may run rather hot.

Total Enclosure. Think of what might happen if the means used to develop such totally enclosed motors were applied to the simple open motor. With silicone insulation, for example, it is quite possible to build a motor that will handle 10 hp continuously in a 2-hp frame. Here's the chance for a big saving.

A new problem arises, however, in that the power factor and efficiency of this "condensed" motor would be objectionably low. Also, thermal expansion must be considered. The materials and process engineer may some day aid the designer by providing electrical sheet steel with greatly improved characteristics. If this should happen, the power factor and efficiency of these smaller motors might be made acceptable.

Cheaper Motors. Induction-motor stators are still fairly complex structures, as the rotors once were. Stator structure will probably some time be simplified by die-casting the frame around the core of laminations.

A lot of the labor spent in building induction motors is in placing the coils in the slot. In the future the mass-produced motors may be machine wound. This would make it well worthwhile to get rid of slot cells now used to insulate the stator conductors from the stator core, perhaps by an insulating coating over the core. Experimental motors, in which the slot cells were replaced by a varnish coating, have worked well. Perhaps an electro-chemically or chemically produced insulating coating may be a better answer to this than a varnish coating.

Less Maintenance. Reduced maintenance is always desirable. Chief cause of motor failure continues to be bearings and windings. The recent progress in adapting sealed ball bearings is a long step in reducing maintenance costs. Such motors have been in service 12 years with no lubrication or change in the bearings. Progress is also being made to reduce winding failures, but there is much room for further improvement.

It is the motor designer's dream that he will some day design and build a winding that can't burn out or fail—a winding too good for the normal service life of the motor.

Speed Control. Then there is the ever-present demand for a drive adjustable in speed over a wide range—even up to 100 to 1—and subject to precise control and perfect regulation over the load range.

That largely explains the continued demand for, and use of, the dc motor. Schemes have been devised to use the dc motor on an ac power suppply. The motor-generator set (adjustable voltage) is unbeatable in performance, but very costly. A number of simplified rotating adjustable-voltage drives are in wide use. Most of these systems call for the dc motor with its commutator. While the commutator has long been viewed askance, it is still the cheapest and most practical wide-speed control device. This may not always be so. Development of a superior tube-type frequency converter might challenge the position of the commutator and enable the induction motor to remain supreme. But this goal is not immediately attainable. Much better electronic motor controls are needed.

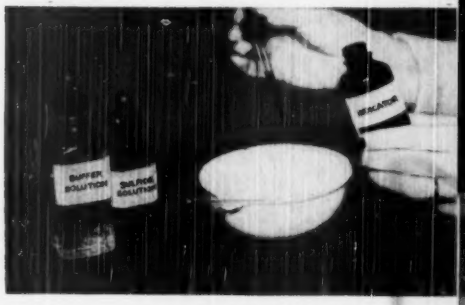
Semi-conductors have already invaded the industrial-control field in the form of copper-oxide and selenium rectifiers, but these simple devices don't permit the control that the grid provides in an electronic tube. However, the recently developed transitor, using semi-conductors, does make the tube-type control possible. At present such devices are limited in power-handling capacity, but fundamentally there is no reason why they cannot be built to handle larger currents and voltages. With their inherent ruggedness, lack of vacuum and lack of cathode, they may eventually replace many present electronic devices and extend control to applications where the electronic feature of today's construction is objectionable.

Some day the open-arc nuisance of present contactors will be done away with. The arc will be completely enclosed—perhaps in a mercury switch with an inert gas or a very high vacuum. With such a contactor, control panels would be smaller, simpler and easier to maintain.

The Perfect Motor. Some day we shall have a burnout-proof motor. The windings, like the bearings, will have indefinite life. Complete thermal and overload protection will be built in, and the motor will contain its own starting equipment. This motor of the future will be a strictly packaged unit requiring only a foundation, electrical leads to a pushbutton and power supply, and shaft connection.

1 For this sequence pour 50 ml of sample into a porcelain evaporating dish (no limitation on sample size other than economy of operation)

2 Add 1 ml of buffer. If interfering materials are present add few drops of sulphide solution



3 Add three or four drops of indicator solution. Sample turns red if any hardness is present

New Water-Hardness Test Is Faster And Gives More Accurate Results

The old soap method for determining total hardness has done a fair job in years past. But it must give way eventually to a simpler and a more precise test that is based on the work of originator G Schwarzenbach and associates

BY V M MARCY
Hall Laboratories, Inc, Pittsburgh, Pa.

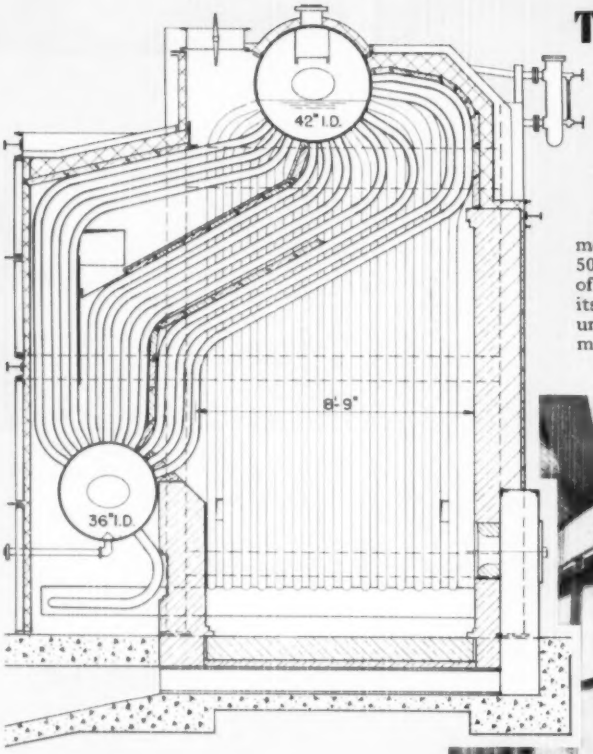
► TOTAL HARDNESS (calcium and magnesium) has customarily been determined in the U.S. by the time-consuming and relatively inaccurate soap method. The procedure has seen little change since Clark's original British patent of 1841. But now Swiss investigators have introduced, within the last two years, a total hardness test that represents greater progress in this field than was made in the whole preceding century. It is based on the work of G Schwarzenbach, W Biedermann and H Ackermann (see References 1 and 2 at end of article).

Version of the test described here includes modifications that make it a little more practical, but the original work

CONTINUED ON PAGE 108

4 Titrate until first tint of blue appears, then slowly to endpoint (pure blue). Multiply ml used by solution factor

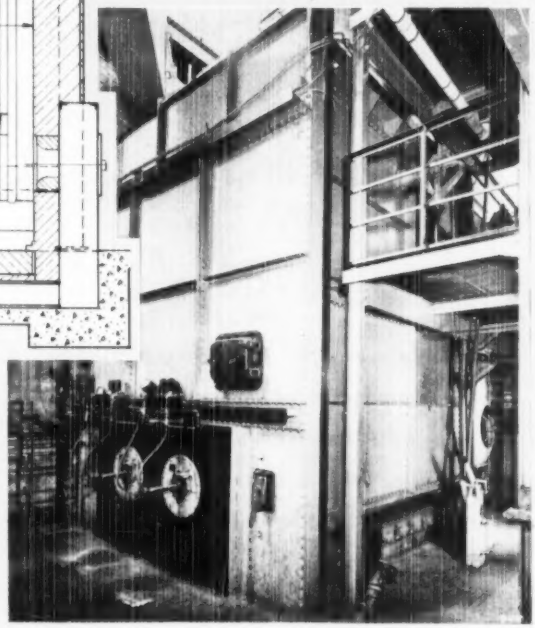
Efficient Boiler Unit for



THE RILEY "RZ" BOILER UNIT

For capacities between 10,000 lbs. and 50,000 lbs. of steam per hour. Adaptable for spreader or underfeed stoker, oil or gas firing.

The Riley "RZ" boiler unit is an efficient modern unit for steam capacities up to 50,000 pounds per hour. While economics of standardization are taken advantage of, its design is sufficiently flexible to provide a unit best suited for the particular requirements of the plant involved.



WORCESTER POLYTECHNIC INSTITUTE
Worcester, Mass.

20,000 lbs./hr. Oil fired
Riley "RZ" Boiler Unit

Photograph of Riley "RZ" Boiler Unit at Worcester Tech.

Note the rugged steel-clad insulated setting assuring permanent tightness.

TRADE MARK Rx REGISTERED

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Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
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the Moderate Sized Plant

THE RILEY "RZ" BOILER UNIT

Rapid Positive Circulation

The design of the Riley "RZ" boiler is based on the ring flow principle of circulation which together with the large height difference between drums assures unusually rapid and positive circulation.

High Efficiency

The design of the Riley "RZ" boiler results in efficient heat transfer from the gases to the boiler water, assuring high efficiency.

Side Walls Water Cooled

Side walls are water cooled to provide large radiant heat absorbing surfaces, to protect side wall refractories and to minimize slagging difficulties.

Steel Clad Insulated Setting

To assure low heat loss by radiation, to eliminate air and gas leakage, and to reduce setting maintenance, a heavily insulated steel clad setting is provided. The rugged steel casing, No. 10 gage flanged panels, not only provides permanent tightness but is sufficiently strong to prevent damage to the setting in case of severe furnace puffs.

Reliability and Low Maintenance

Because of rapid positive circulation and the substantial setting construction, low maintenance and long periods of uninterrupted service are assured.

One Contract—Undivided Responsibility

Riley manufactures all types of fuel burning as well as steam generating equipment so that the complete unit can be purchased from Riley with undivided responsibility. The proper co-ordination of boiler and fuel burning equipment is assured.

Riley "RZ" boilers are constructed and designed to the same high standards as are large Riley central station units.

All of these well-known companies have purchased Riley boiler units of steam capacities under 50,000 lbs/hr.

SCHUTTE & KOERTING CO.
U. S. VANADIUM CORP.
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CLUETT PEABODY & CO.
HART SCHAFFNER & MARX

KENNECOTT COPPER CO.
SHERWIN WILLIAMS CO.
CLARK EQUIPMENT CO.
NUNN BUSH SHOE CO.
U. S. GYPSUM CO.

GENERAL TIME INSTRUMENT CO.
SWIFT & COMPANY
CELANESE CORP. OF AMERICA
CONGOLEUM NAIRN, INC.
NICHOLSON FILE CO.

BOEING AIRCRAFT CORP.
SCOVILL MFG. CO.
GENERAL MOTORS CORP.
GENERAL FOODS CORP.
PULLMAN STANDARD CAR MFG. CO.

MONSANTO CHEMICAL CO.
THE BULLARD CO.
GENERAL ELECTRIC CO.
EAGLE PICHER LEAD CO.
MODINE MFG. CO.

While Riley has installed some of the largest boiler units in the country, a large portion of their sales are for units under 50,000 lbs. of steam per hour.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS

WATER-HARDNESS TEST *CONTINUED*

of Schwarzenbach and associates comprised a complete and consistent method, including means for eliminating interferences.

Procedure. The water sample is buffered at a pH of about 10, and then, when necessary, sulphide solution is added to eliminate interfering substances. An organic indicator, chrome-black *T*, is added and the sample titrated with a standardized solution of disodium salt of ethylene-diamine-tetra-acetic acid. The indicator turns the sample red; titration changes the color to a definite blue. The endpoint, occurring when the last trace of reddish tinge disappears, is sharp and readily detected. Thus the test is more accurate than older methods, and so simple it can be made in one to two minutes.

How Test Works. Indicator is blue at a pH of 10 in a hardness-free water. When hardness is present under the same conditions, calcium and magnesium react with the indicator to produce soluble red compounds. Color of the magnesium compound is a purer and more definite red than calcium. The titrating solution of ethylene-diamine-tetra-acetic acid salt extracts calcium and then magnesium from the indicator compounds, forming colorless "complexes." The complexes remain in solution but do not permit calcium and magnesium to react as they usually would. When all hardness is tied up, the indicator reverts to its normal blue color.

Sulphide Solution. Most waters do not contain enough interfering materials to affect results. But those containing even fairly small amounts of copper and manganese require a special reagent to eliminate their interference. If the special reagent is not added, the red color fades slightly if copper is present, and no color change occurs at the endpoint. When manganese is present, the indicator rapidly fades to a light blue-gray.

Originators of the new test recommend adding cyanide to minimize these interferences. Sodium sulphide is more effective and is, of course, potentially much less toxic. Since sulphide is needed only infrequently, it is advantageously added in the form of a separate, highly alkaline solution, which remains quite stable. A preliminary test on a given water, with the omission of sulphide, has the virtue already mentioned of providing a qualitative evaluation of certain interfering materials.

Table I shows the amounts of common substances that may be present in the test solution without affecting results. This table is based on the use of sulphide reagent.

Summary. Test is sensitive to small amounts of hardness. With no special precautions, 1 ppm of hardness as $CaCO_3$ can be detected. With special techniques and more dilute titrating solutions, even lower concentrations can be determined. There is no limitation on sample size, other than economy of operation, since no scum or salt effect can obscure the endpoint. The method is applicable to high or low hardness in even fairly concentrated brines. It is extremely rapid.

REFERENCES

1. Biedermann, W, and Schwarzenbach, G, *Chimia*, 2, 56-59 (1948).
2. Schwarzenbach, G, and Ackermann, H, *Helvetica Chimica Acta*, 30, 1798-1804 (1947).

TABLE I—INFLUENCE OF VARIOUS CONSTITUENTS IN WATER SAMPLE

The concentrations shown permit running a test on water containing 17.1 ppm (1 grain per gallon) of hardness expressed as $CaCO_3$, with an accuracy of ± 1 ppm. Sulphide solution is used.

Constituent	*Concentration, ppm*	*Remarks*
Chloride	25,000	Indicator fades slightly with higher concentrations.
Sulphate	10,000	Poor endpoint results with higher concentrations.
Sulphite	1000	Higher concentrations may be tolerated but are seldom encountered.
Nitrate	1000	
Silicate as SiO_2	1000	
Chlorine	500	
Chromate	100	With higher concentrations, chromate produces a green instead of a blue color at the endpoint.
Orthophosphate	75	Poor endpoint and low results produced with higher concentrations.
Metaphosphate	25	Poor endpoint and low results produced with higher concentrations.
Aluminum	25	Endpoint delayed for higher concentrations by adsorption of indicator on aluminum hydroxide flock.
Ferrous iron	15	Larger quantities will tend to obscure endpoint.
Ferric iron	15	Offshade color produced with higher concentrations.
Zinc	10	With higher concentrations, zinc is partly titrated along with the hardness.
Copper	5	Slightly higher concentrations can be tolerated if more sulphide is added.
Manganese	2	With higher concentrations, manganese is partly titrated and more indicator is required.
Nickel	0.2	10-ppm concentration permissible if cyanide is added.

TABLE II—REAGENTS NEEDED

Reagents* for the test consist of buffer, sulphide, indicator and titrating solutions.

Buffer solution contains ammonium hydroxide and ammonium chloride together with a small amount of magnesium and a corresponding quantity of disodium salt of ethylene-diamine-tetra-acetic acid. The last two materials assure a good color change even when magnesium content is low.

Sulphide solution contains sodium sulphide, also sodium hydroxide to suppress hydrogen-sulphide evolution.

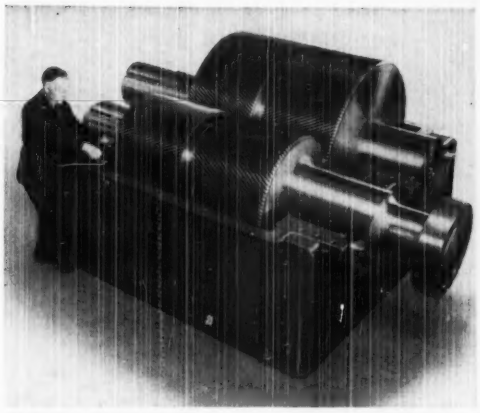
Indicator solution is made up periodically by adding adjusted chrome-black *T* to methyl alcohol. Solution is stable about a month. As a matter of convenience, a standard amount of solid, adjusted chrome-black *T* can be supplied in capsule form.

Titrating solution contains the complex-forming disodium salt of ethylene-diamine-tetra-acetic acid. Solutions are available of which 1 ml is equal to 17.1 ppm (1 grain per gal) or to 20 ppm calcium carbonate, based on a 50-ml sample of water.

*Available from Hagan Corporation of Pittsburgh, Pa.

LETTERS FROM A TURBINE SPECIALIST—6

By E W BURSTADT and J KLUZAK, *Turbine Divisions, General Electric Co.*



DRIVE-GEAR SUITABILITY depends on character of the load, material, design, builder's experience, fabrication precision

STUDY ALL FACTORS WHEN BUYING GEARS

Turbine Specialist
District Office

Dear Mr. Specialist:

In your recent proposal covering a turbine and gear to drive our large induced-draft fan you mention that a single-reduction gear will be furnished. You give me no way, however, of determining whether this gear is of conservative design or not.

I understand that the *K* factor on a gear indicates how conservatively it has been designed. The gear with the lowest factor will have a longer life than one with a high factor.

Please give me a good explanation of this *K* factor, with any other information that might help me choose the best gear. I've had very little to do with gear units since most of our fans and pumps are motor driven.

Very truly yours,
ENGINEER

Dear Mr Engineer,

"*K*" factor is a term adopted by the American Gear Manufacturers Association and the gear industry to denote the severity of tooth loading on a gear set. Maximum values of *K* have been assigned for different applications, found in the industrial field, on the basis of a gear set meeting certain standards of design and manufacture.

On generator drives, which are relatively smooth loads, *K* has been set fairly high at maximum demand on the generator. For other applications involving non-uniform loading or shock loads on the gear teeth, a lower value of *K* has been assigned.

These values are based on the recommendations of gear manufacturers who have found from experience the maximum tooth loading that gives reasonably long gear life without excessive maintenance.

Unfortunately, from the buyer's angle, *K* does not tell the whole story. It is possible to buy two gears, one with a *K* of 100 and another of 200. Under the same loading the one having seemingly conservative *K* of 100 may fail, whereas the other may run indefinitely. This is because the mathematical calculation of *K* does not take into account the following important items:

Materials. A gear rotor can be made of cast iron, and calculation of *K* will be same as for highest-quality steel.

Precision in Manufacture. Accuracy in tooth spacing, surface finish of the teeth, and percentage of tooth contact across the gear face are just some of the items that are not reflected in the calculation of *K*.

Know How. Important design items such as lubrication are in this category, along with manufacturing experience.

The question may well be asked, "Why has such an index been established as a measure of gear loading?" For a gear manufacturer, who has fixed standards on materials and manufacturing processes, *K* factor is a handy tool in aiding the designer to choose proper proportions of a gear rotor. *K* bears a definite relation to the actual compressive stress to which teeth are subjected under load. On a comparative basis it is a good index of gear loading.

The factor is practically meaningless when compared among several manufacturers of gearing unless the assumption is made that they all build to the same standards. This is doubtful.

To obtain higher operating efficiencies and more economical use of materials, the modern trend is to design power-developing and -transmitting machinery in smaller packages. At the same time, reliability is maintained and improved. In keeping with this trend, gear sets are being designed and built with *K* factors higher than in past practice.

Gearing for specialized applications has been built with *K* approaching 2000, pinion speeds up to 53,000 rpm, and ratings in excess of 50,000 hp. To design and manufacture gearing of the foregoing types requires extreme diligence in design and the highest perfection of manufacturing.

Assurance of long life, reliability and quiet operation of a gear is dependent on its design, material and workmanship. Only to a limited extent need the *K* factor be considered in the purchase of a gear for any given service.

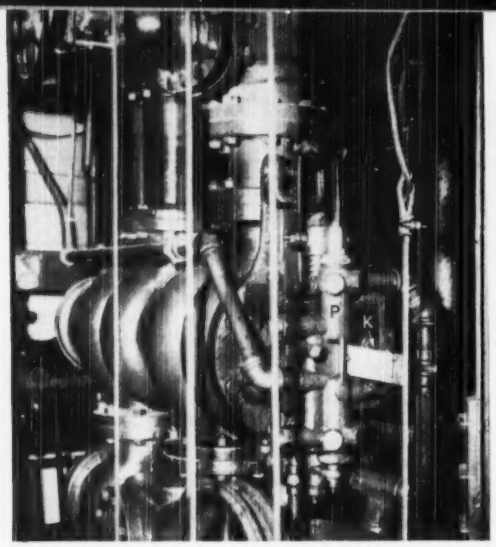
Sincerely,
TURBINE SPECIALIST

P. S. As a matter of record, the equation for finding *K* is,

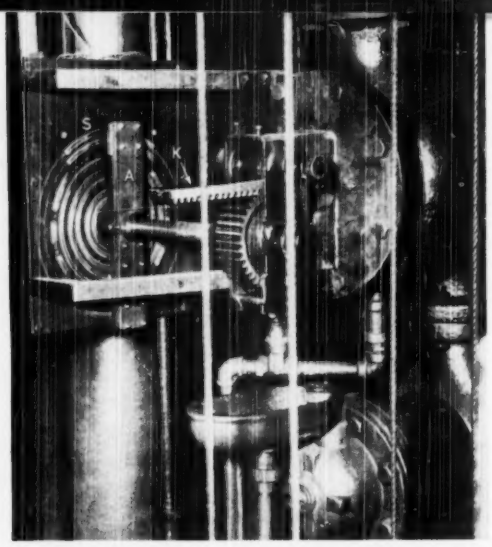
$$K = \frac{P}{Fd}\left[\frac{R+1}{R}\right]$$

where: P = tangential tooth pressure, pounds
F = active face width, inches
d = pinion pitch diameter, inches
R = gear ratio

Values for above factors can be found in some handbooks.



1 One of the main operating valves on which was mounted mechanically operated pilot valve *P*. It has now been removed



2 Electric-control speed selector replaces the old pilot valve and is actuated by a rack and gear from main valve

Electric Control Adds New Look to

Skyscraper's 20 plunger hydraulic elevators shift from mechanical to 4-speed car-switch electric control. This includes automatic car leveling at floors, car-gate and hoist-door interlocks to improve service with increased elevator operating safety

► Older types of hydraulic elevators have mechanical controls, usually a system of levers and ropes to position the pilot valves. These controls are not readily adapted to include the desirable features found on modern electric elevators. But an electric control has now been developed for hydraulic elevators that makes them comparable to electric designs for smooth, safe operation. The Hydraulic Elevator & Machine Co is installing such a control on 20 hydraulic plunger elevators in the 165 Broadway Building, New York City. Some of these elevators have a 380-ft rise, which is the world's highest for their type.

Old Controls. Original control of these elevators was from a lever in the car. Through a system of ropes, sheaves and levers, it operated the pilot and main valves, Fig. 1. These valves control the flow of pressure water to and from the plunger cylinder to lift or lower the car in the hoistway. In the new control the main valve is controlled from a car switch, Fig. 6, similar to that on an electric elevator.

Automatic Floor Leveling. Electric control automatically levels the car at the floors, and keeps it level as long as the car switch is centered. This eliminates one of the hazards of the old mechanical controls. If the valves or packing leaked the car would creep away from the floor. With the electric control, if the car creeps even less than an inch it is automatically returned to the floor.

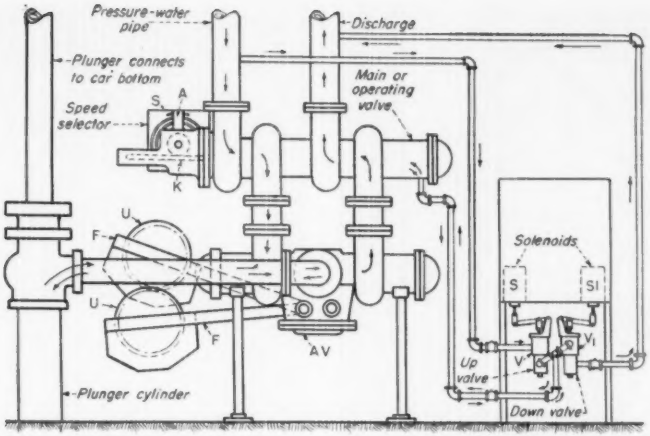
The automatic leveler makes it easier for the operator to land the car level with the floors. It speeds up elevator service, within the limits of safe operation, because the car comes quickly to the floors and stops level without being inched by the operator. Having the car always stop level at the floors permits passengers to move in and out faster. This helps to speed up service.

The new control also includes electrical interlocks on the hoistway doors and the car gate. They prevent the car being started until the hoistway doors are closed and locked, and the car gate closed. These features, combined with automatic car leveling, practically eliminate landing hazards as completely as on modern electric elevators.

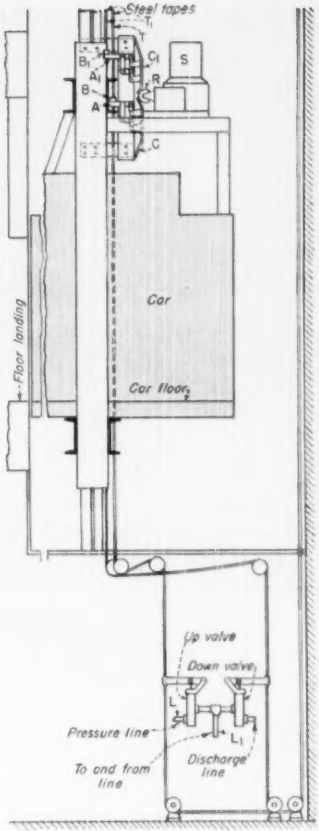
Main-Valve Operation. Fig. 3 shows the old main or operating-valve layout with the new equipment installed. Speed selector is now mounted where the original pilot valve was. This valve was opened and closed by a system of levers and ropes connected to the operating lever in the car. Pressure water through the pilot valve positioned the operating valve to admit water to or release it from the plunger cylinder.

Rack *K*, on the end of the operating valve's stem, meshed with a gear on the pilot-valve *P* mechanism, Fig. 1. Then when the operating valve moved, it returned the pilot valve to neutral. This stopped the operating valve at an opening to pass water enough to give the car a speed corresponding to the position of the car-operating lever.

Pilot Valve. To install the new control the old pilot valve and its operating mechanism were replaced by a speed selector *S*, Fig. 2 and 3. This selector consists of a square disk of insulating material with circular contacts on it. An arm *A* has contacts that ride on the circular ones. This arm is geared into the rack *K* of the original pilot-valve compensation and is swung through an



3 On the new control the main operating valve is put into operation by the solenoid-actuated pilot valves on the right. It is stopped by the speed selector



4 Car leveling and anti-creep control is from car's solenoid-actuated roller *R*, pair of cams *C* and C_1 at each floor that operate the up-and-down leveling valves

Old Hydraulic Elevators

arc as the operating valve moves, to select the car's operating speed.

The pilot valve was replaced by two solenoid-operated valves *V* and V_1—one for car motion up, and one for down, Fig. 3 and 7. The valves connect into the pressure and exhaust lines and the valve-operating cylinder as in Fig. 3.

Four-Speed Car Switch. On the car the operating lever is replaced by a 4-speed car switch of special design, Fig. 6. The up and the down circuits are made in the car switch, but are broken through the speed selector on the operating valve. Also, movement of the car switch closes the car-direction circuit.

Assume the car switch is centered and the car stopped at a floor. If the switch is moved only slightly off center it picks up the circuit for the direction magnet, say, up. Further movement of the switch picks up the speed circuits, say, full speed. This circuit through suitable relays and contactors energizes the up solenoid *S*, which opens up pilot valve *V*. Opening this valve admits water from the pressure line into the right-hand end of the operating-valve cylinder. This valve moves to the left, and water flows from the pressure line into the plunger cylinder to lift the car.

As the operating valve travels to the left it turns the selector switch, by action of the rack and pinion. When the operating valve nears full-speed position, the selector breaks the solenoid circuit and the pilot valve comes to neutral to keep the operating valve positioned. Under this condition all control circuits are open, but the car switch must remain full-on until slow down is initiated.

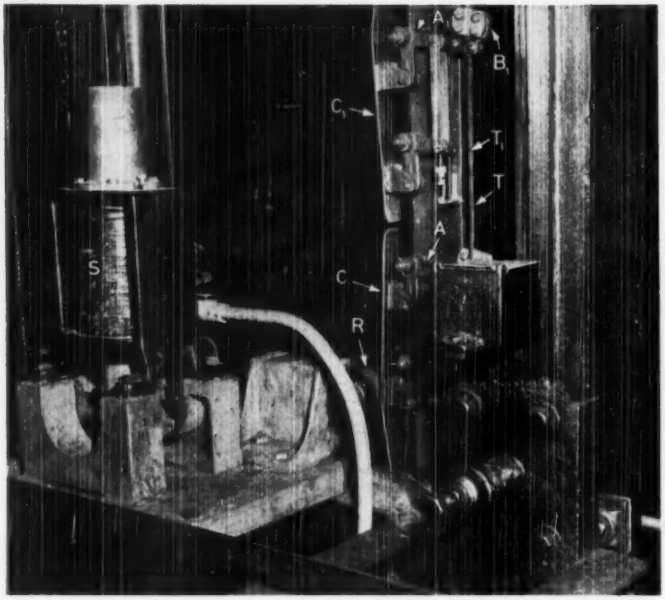
Slow-Down Operation. If the car switch is moved back to third speed, it first closes its down-solenoid contacts. Further movement of the car switch picks up its third-speed contact to energize the down solenoid S_1, to open its pilot valve V_1. This permits pressure water to flow from the right-hand end of the operating-valve cylinder through the pilot valve into the exhaust line.

The operating valve moves to the right to reduce water flow to the plunger cylinder, and the car slows down. As the control valve moves to the right, it moves the speed selector. When the selector reaches the third-speed position it breaks the solenoid circuit. The down-pilot valve then returns to neutral to stop movement of the operating valve.

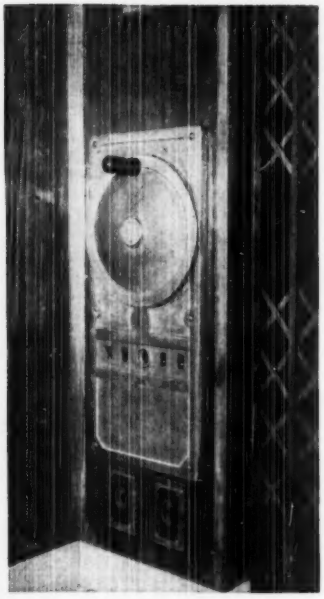
Moving the car switch to first speed again energizes the down-pilot valve solenoid to open this valve, and causes the operating valve to move toward the closed position. When it approaches first speed, the speed selector opens the solenoid S_1 circuit and the down pilot valve comes to neutral to hold first speed. Centering the car switch, as the car nears the floor, again energizes down solenoid S_1. The operating valve comes to center to stop the car at the floor.

Automatic Car Leveler. Centering the car switch, as the car approaches the floor, energizes a solenoid on top of the car, Fig. 4 and 5, to actuate the automatic leveler or anti-creep control. The leveler consists of a pair of cams *C* and C_1, mounted on a car rail at each floor. These cams connect by a toggle linkage to two arms *A* and A_1. Steel tape *T* connects to a spring in the overhead work, comes down the hoistway and passes through a slot in arm *A*. It then goes to the valve room where it connects to the up valve. The tape continues and goes up the hoistway to another overhead connection.

A similar tape, T_1, comes down the



5 Solenoid *S* and roller *R* move cam *C* to lift arm *A*. This arm, through tape *T*, lifts the up valve to admit water to the plunger cylinder to level the car



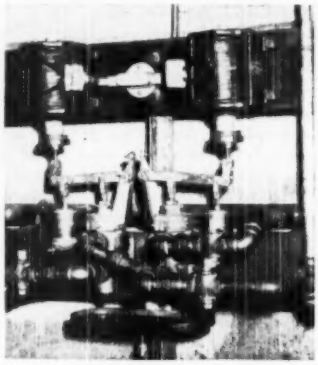
6 Four-speed floor-leveling car switch replaces mechanical-lever control

hoistway and passes through a slot in arm A_1 of the down cam and to the down valve in the valve room. This tape continues up the hoistway and connects to the overhead. On the tapes at each arm is a stop B and B_1.

How Leveler Operates. Assume the car level at the floor as in Fig. 4, the car switch centered, and its handle released by the operator. Releasing the handle closes a contact that energizes solenoid S on top of the car to push roller R to the position in Fig. 4. In this position the roller just clears cams C and C_1 when they are in full released position.

Any small movement of the car up or down, away from the floor, causes roller R to depress one of the cams. Assume that packing around the plunger leaks and lets the car settle below the floor. When roller R rides down on cam C, arm A moves up to lift the lever on the up valve. Opening this valve admits pressure water through line L directly into the plunger cylinder to return the car to the floor. When the car comes to the floor, roller R moves up between the cams, and the car stops.

The same operation takes place when the car is coming to a floor. Assume the operator centers the car switch and releases its handle, and the operating valve closes when the car is six inches



7 Solenoid-actuated up-and-down pilot valves replace old mechanical ones that used to operate the main valves

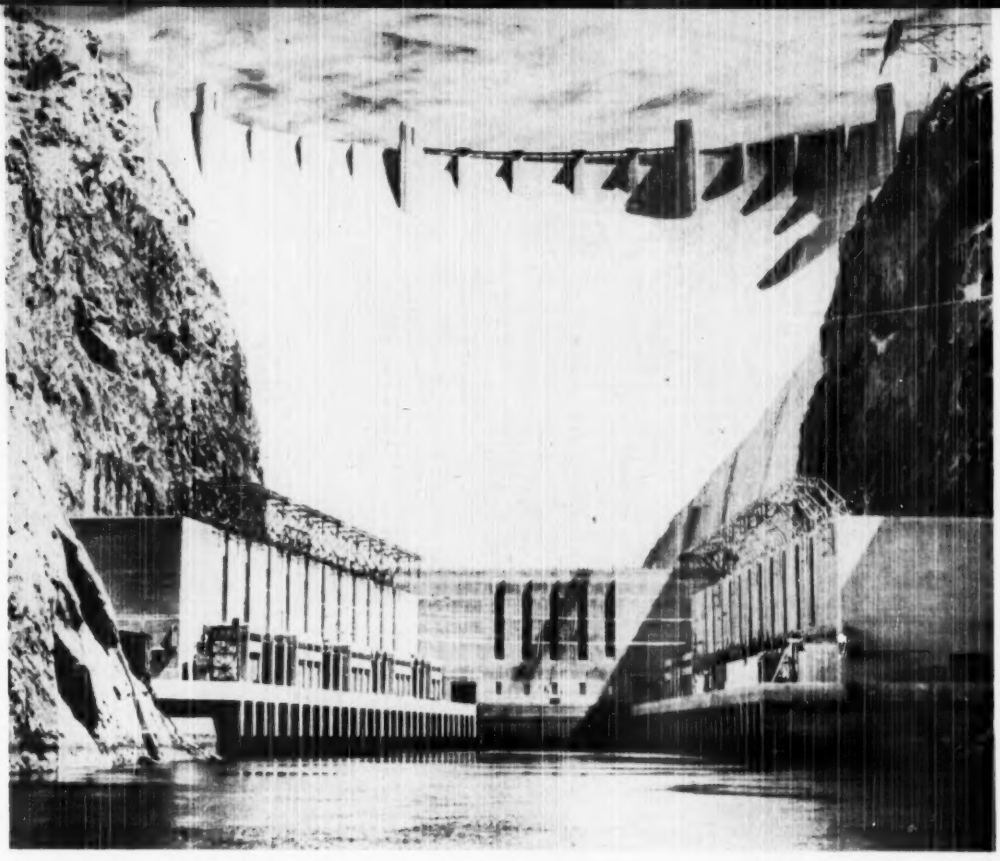
below the floor. Solenoid S would force roller R out against cam C. This would open the up leveling valve and admit water directly to the plunger cylinder to level the car up to the floor.

If the plunger's packing leaks badly, the car does not come exactly level with the floor but stops a short distance below. At this point the up valve is held open just enough to supply water to the plunger cylinder as fast as it leaks out, and the car is held nearly level to the floor.

The leveling device first serves to land the car. After doing this, it becomes an anti-creep device to hold the car level with the floor. Operation of the leveler has been explained, assuming the car in the up motion. Similar control actions take place when the car is in down motion.

In the change-over, the original top and bottom limits have not been disturbed. These are still operated by ropes, which are (1) attached to top and bottom of the car and (2) run over sheaves in the overhead and sheaves U at the end of levers F, which connect to automatic stop valves AV, Fig. 3. As the car approaches the top or bottom floors a corresponding stop valve is positioned to bring the car level at the landing. The automatic leveler also takes over to ensure the car stopping level at the terminal landings.

POWER editors express appreciation to the 165 Broadway Corp for permission to publish this article. For assistance in writing it, they are indebted to Frank Shinn, chief engineer of the building, and to John A Rogers, M N Nyberg and J N Nyberg, engineers of Hydraulic Elevator & Machine Co.



HOOVER DAM AND POWER HOUSE. The dam is 726 ft high from its lowest point to its crest, almost 200 ft higher than any other dam in the world. It is 660 ft thick at its base measured up and down stream, and has a crest length of 1244 ft

Hoover Dam Tops 50 Billion Kwhr

Highlights of power-plant operation during more than eleven years of power generation and river regulation. Two 115,000-hp units on order will raise the plant-installed capacity to 1,672,000 hp

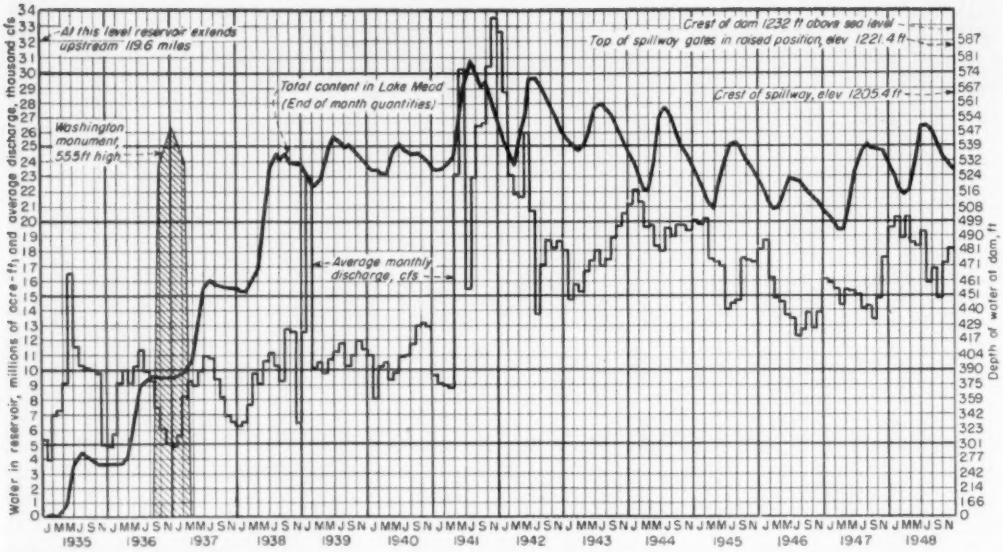
► TWO MORE 115,000-HP UNITS have been ordered for Hoover Dam power plant. This announcement again directs attention to a great project and what it has accomplished. Broadly, the achievement is greater than those who conceived and constructed it could have anticipated.

Before-and-After Facts. Before construction of Hoover Dam, by U.S. Bureau of Reclamation under the Secretary of the Interior, the Colorado River repeatedly flooded and damaged large areas of valuable agricultural land. To keep the river under control, levees were built and rebuilt—larger and larger, and at great cost. But as silt filled the channel the river would sweep over its banks. Before storage began in 1935 above the Dam in the reservoir, floods and silt caused about $1 million annual damage to lands and irrigation canals on the lower river.

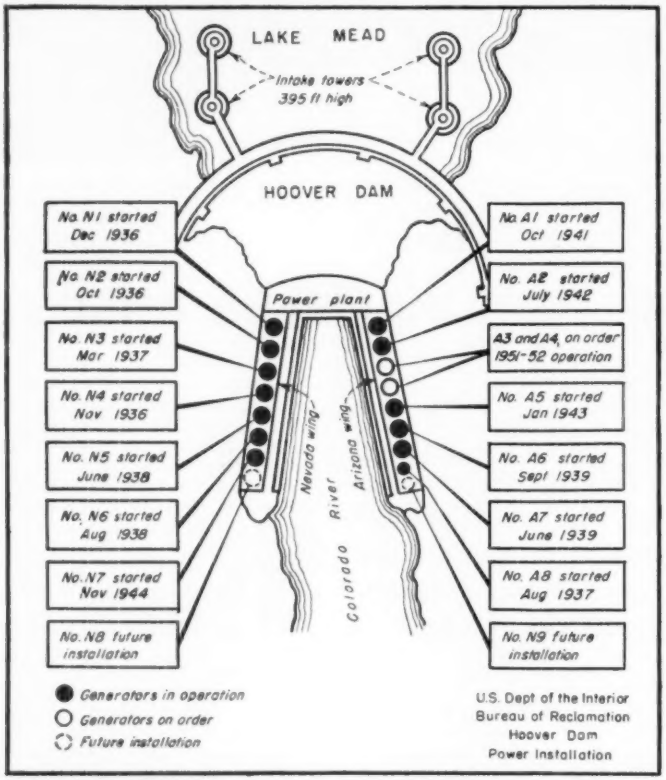
Building the Dam changed all that. Water is available for two million acres of rich land, 25% of which are now under intense cultivation. Large blocks of low-cost power are being generated. Water released from the reservoir has supplemented domestic and industrial water supplies of Los Angeles and 12 other cities.

Disastrous floods, once a constant menace to 100,000 people, are now a thing of the past. Navigation is improved below the Dam, and above it a national playground and recreational area has been created. The reservoir is also an important wild life and bird refuge.

When the contract was let for construction, in March 1931, no one could foresee that in 18 years nearly 1,700,000 hp of power-generating capacity would be installed or on order and the plant would have generated over 50 billion kwhr. **Diagram on next page** shows the units installed and on order and


All this level reservoir extends upstream 119.6 miles
Total content in Lake Mead (End of month quantities)
Crest of dam 1232 ft above sea level
Top of spillway gates in raised position, elev 1221.4 ft
Crest of spillway, elev 1205.4 ft
Washington monument, 555 ft high
Average monthly discharge, cfs
Water in reservoir, millions of acre-ft, and average discharge, thousand cfs
Depth of water at dam, ft
J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N J M M J S N
1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948

LAKE MEAD WATER STORAGE. Curves show water stored in and discharged from the reservoir. When full, it extends upstream for 119 miles and stores over 31 million acre-ft. The amount is equal to two normal years' flow of the Colorado River



POWER-UNIT INSTALLATION. Plant planned for fifteen 115,000-hp and two 55,000-hp main units, and two 3500-hp service units, totaling 1,842,000 hp at 520-ft head

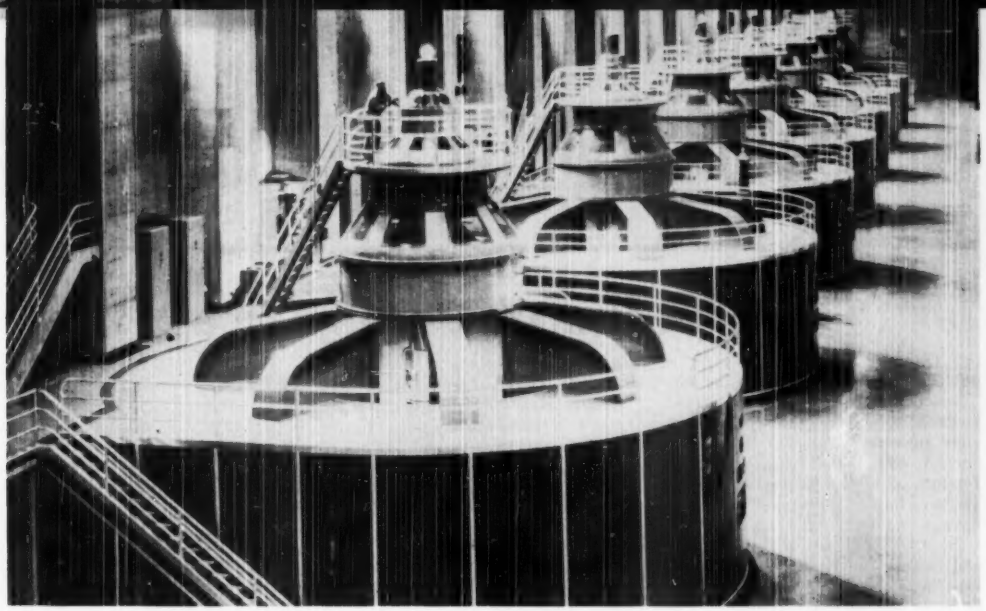
when they went or will go into service.

Interesting Features. Hoover Dam is 726 ft high from lowest point to crest, almost 200 ft higher than any other dam. Its base is 660 ft thick, measured up and down stream. With a crest length of 1244 ft, it contains 3,250,000 cu ft of concrete. This is a greater volume of material than in Egypt's great pyramid of Cheops, which held the record 3000 years.

The Dam also forms the world's largest artificial reservoir by volume, which is now known as Lake Mead. When filled to the top of the spillway gates the reservoir has a maximum depth of 567 ft, extends up river 119 mi. With a 550-mi shore line and 229-sq-mi area, it can store about 31 million acre-ft.

To build the Dam the river was diverted around the site through four concrete-lined tunnels, 50 ft in diameter. Since the tunnels were closed to fill the reservoir in February 1935, the Colorado River below the dam has been under complete control.

In June of that year, nearly 4 million acre-ft were stored back of the Dam. If this water had gone down the river uncontrolled it would have caused destructive floods. Later in the year, river flow dropped to 500 sec-ft above the Dam, which would have resulted in a serious irrigation water shortage. But because of the water stored during the June flood a flow of 10,000 sec-ft was



POWER-HOUSE INTERIOR. Nevada wing of power house has seven 82,500-kva generators installed, with space for eighth unit. Installation of two units now on order will complete the Arizona wing with the exception of one 40,000-kva machine

maintained below the Dam, the amount needed to meet irrigation requirements.

To fill the reservoir required the river's total flow for seven years, less than needed for irrigation and power generation. Water flowed over the spillway for the first time on August 6, 1941. At that time nearly 31,000,000 acre-ft of water were stored in Lake Mead.

Since then, water level has been below the spillway's crest. Because of poor water years and the heavy drawdown for power generation during the war the reservoir level has remained abnormally low.

Before Hoover Dam was built, river flow below its site varied from as low as 1200 sec-ft to as much as 250,000 sec-ft with an annual flow of 17,500,000 acre-ft. During the heaviest recent flood, which occurred in 1938, over 9 million acre-ft of water were stored in Lake Mead in about four months and nearly 2 million passed through the plant.

Since the bypass tunnels were closed, average monthly discharge from Lake Mead has not exceeded 34,000 cfs, and since 1941 minimum flow has not been less than 12,000 cfs, as the curves show.

Plant Layout. Diagram shows the plant laid out for 15 large units and two small ones. Large ones are rated 115,000 hp, and small ones 55,000 hp under a 520-ft head. These with two 3500-hp service units will give an ultimate capacity of 1,842,000 hp.

First large unit went into service in October 1936, and by November 1944 12 large ones and a small one were in operation. Two more large units are on order for 1951 and 1952. When they are in service, capacity will be 1,672,000 hp. This will make it next to the largest power installation in the world, exceeded only by Grand Coulee. Practically all power from Hoover Dam plant goes into Southern California.

As shown in the table, up to May 31, 1949 the plant generated over 50 billion kwhr, making it one of the world's great power producers. During the 1943-44 operating year, power production reached its annual maximum of over six-billion kwhr. It also passed six-billion kwhr in 1944-45 operating year.

Up to May 31, 1948, in cash advanced and accrued interest the project has cost the U.S. nearly $182 million, of which about $41 million is interest. Out of plant income from power sales and other sources, over $50 million has been repaid to the U.S. Treasury, leaving less than $131 million to be repaid.

Lake Mead, Hoover Dam and power house have become one of the great recreational areas under the National Park Service. From June 1 to Dec. 7, 1941, 212,855 visitors paid 25c admission fee to the power house. In addition, 26,530 children under 16 and 12,703 other visitors and employes were admitted free, a total of over 250,000 in a little over seven months. During the war visitors were not admitted, but in 1946, 1947 and 1948, a total of 1,186,655 were taken through the plant.

Two Plants Below Hoover. Davis Dam, 67 mi downstream, will back water to tailwater level of Hoover and form a storage reservoir of 1,800,000 acre-ft. Five 62,200-hp units are being installed to operate under a 140-ft head, a total of 311,000 hp. Present schedule calls for initial operation in 1950.

Eighty miles below Davis is Parker Dam and power house with four 40,000-hp units, a total of 160,000 hp for an 85-ft head. The reservoir formed by this dam is the intake for the aqueduct of the Metropolitan Water District of Southern California, which serves Los Angeles and 12 nearby cities with water for domestic use.

Kwhr Generated and Peak Loads

Hoover Dam plant's operating year ending May 31, '49	Gross generation, thousand kwhr	Annual peak load, kw
1937	512,836	——
1937-38	1,422,353	——
1938-39	1,631,954	——
1939-40	2,805,101	——
1940-41	3,140,939	690,000
1941-42	3,295,033	710,000
1942-43	5,098,860	980,000
1943-44	6,309,786	1,010,000
1944-45	6,082,393	1,000,000
1945-46	5,047,104	1,010,000
1946-47	4,309,160	1,010,000
1947-48	5,345,999	1,120,000
1948-49	5,787,886	1,111,700

Total kwhr, 50,789,404,000.

Net power generation, total generation less plant use, 50,641,232,000 kwhr.

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

21—How Electronic Oscillators Operate

► IN RESONANT AND OSCILLATING CIRCUITS, current surges back and forth, generally at high frequency. These circuits are usually supplied from direct current and contain capacitors and reactors. They are, therefore, a means of converting direct current into alternating.

Such circuits are used for induction and dielectric heating, control and metering devices, and for many other purposes. Let's study circuits that resonate or oscillate so that later when we deal with devices that contain them we will know how they operate.

Oscillator Operation. Fig. 1 to 5 show how dc may be converted into ac with a suitable capacitor and reactor, connected in parallel. If the switch is closed to the left, Fig. 1, the capacitor will be charged to battery voltage of the polarity shown. Closing the switch to the right, Fig. 2, connects the capacitor to the reactor, through which the former tries to discharge, as indicated. As current increases in the circuit a magnetic field develops around the coil.

As the magnetic field increases it generates a voltage in the coil that opposes the increase in current. But current flow increases in the circuit until the capacitor is discharged. Energy that was stored in the capacitor has now been transferred to the magnetic field of the reactor. Fig. 2 shows this condition. Here the capacitor has no charge, but a magnetic field has built up around the reactor coil.

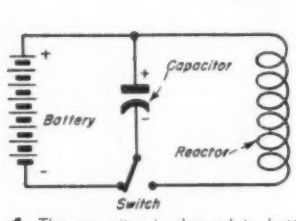
When current flow starts to decrease, the coil's magnetic field begins to collapse, and generates a voltage to keep the current flowing. This charges the capacitor, Fig. 3, to the opposite polarity of Fig. 1. When this operation is completed, energy stored in the coil's magnetic field has been put into the capacitor.

The capacitor again discharges through the reactor, Fig. 4, but in reverse to Fig. 2. Its energy is first stored in the magnetic field of the coil as shown. Then, as the current decays in the circuit the energy stored in the magnetic field charges the capacitor as in Fig. 5.

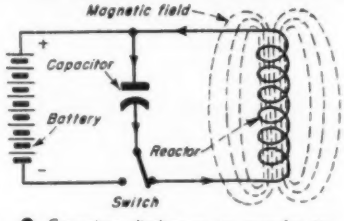
Capacitor's Charge Decreases. Charge in the capacitor, Fig. 5, is not so great as that we started with in Fig. 1, because some of the energy has been expended in the circuit's resistance. Consequently, each time the capacitor charges and discharges, the charge becomes less, until the energy of the original charge is dissipated in the circuit's resistance. If we used an oscilloscope to record the ac wave in the oscillating circuit, it would look something like Fig. 6. Each succeeding wave would become smaller until the charge in the capacitor was dissipated.

To keep the circuit oscillating we must feed energy into it to make up the losses. When the circuit has returned to the condition in Fig. 5, the capacitor has the same polarity as in Fig. 1, but at a lower voltage. If we could instantly throw the switch to the battery and back again to the reactor, the capacitor

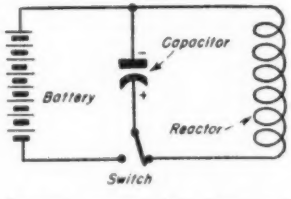
Simplified Diagrams of Oscillator Circuits



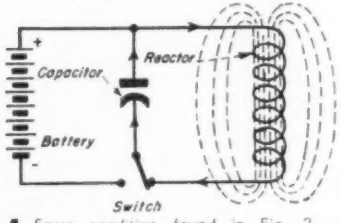
1 The capacitor is charged to battery voltage and to the polarity shown



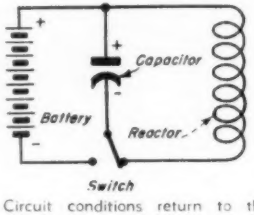
2 Capacitor discharges to transfer its energy to reactor's magnetic field



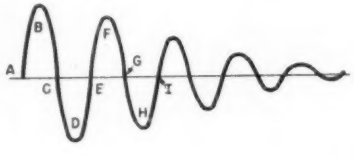
3 Reactor's magnetic field decays and its energy is stored in the capacitor



4 Same condition found in Fig. 2, but polarity and current flow reverse



5 Circuit conditions return to those in Fig. 1, but at a lower voltage



6 Here's how the voltage of a capacitor decreases during each discharge cycle

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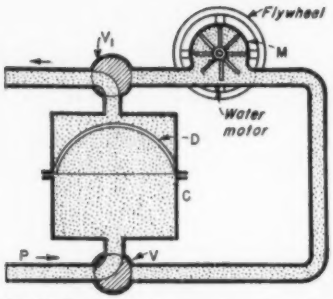
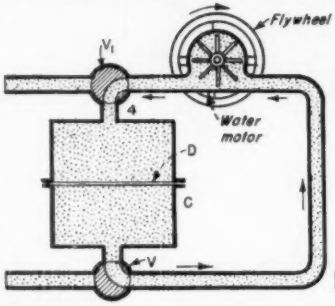
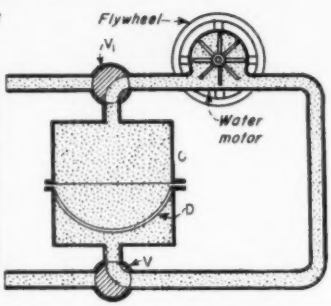
Hydraulic Analogies and Feedback Circuits



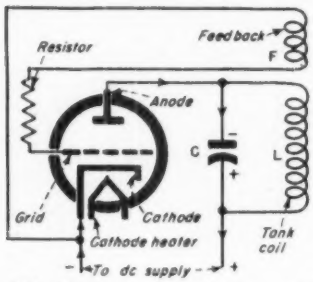
7 Hydraulic analogy of Fig. 1 after capacitor is charged to full voltage



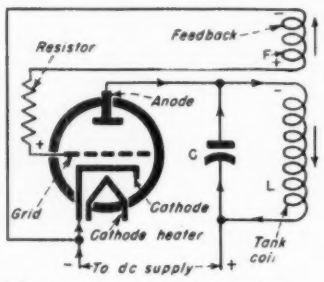
8 Hydraulic analogy of Fig. 2 after capacitor's energy is put into reactor



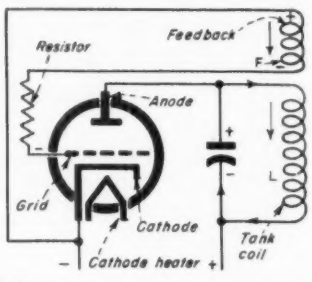
9 Hydraulic analogy of Fig. 3 after reactor put its energy into capacitor



10 Simplest form of electronic oscillator with a feedback from reactor



11 Capacitor discharges through reactor, feedback gives grid a plus bias



12 Reactor gives up its energy to the capacitor, grid is given minus bias

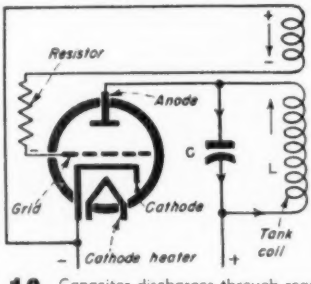
would again be charged to the voltage in Fig. 1.

The capacitor would then repeat the cycle *ABCDE*, Fig. 6, and not drop to a lower value such as *EFGHI*, as it would unless given an energy shot. Therefore, after each cycle if we had some means to restore the capacitor's charge the circuit would continue to oscillate at a frequency determined by its design.

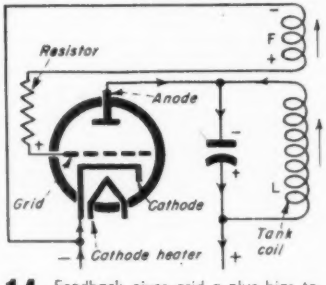
Hydraulic Analogy of Oscillator. Later in this article we will learn how a feedback is used to maintain oscillation in a resonant circuit. But first let us study a hydraulic analogy of an oscillating circuit, Fig. 7, which is the equivalent of Fig. 1. Assume the system is filled with water and *P* is the pressure pipe. Cylinder *C* with its elastic diaphragm *D* serves the purpose of the capacitor, Fig. 1 to 5. Water motor *M* with its flywheel represents the reactor in the electric circuit.

If valves *V* and V_1 are opened to the line as in Fig. 7, high-pressure water flows up into the cylinder to expand diaphragm *D* as shown. Energy is now stored in the diaphragm as in the capacitor, Fig. 1. Positioning the valves, as in Fig. 8, permits the diaphragm to contract and force water through motor *M* to accelerate it. When the diaphragm contracts to its horizontal position it has transferred its energy to the water motor and flywheel, which are rotating.

The motor now becomes a pump driven by energy stored in the flywheel to drive water into the top side of the cylinder and deflect its diaphragm downward, Fig. 9. When the flywheel has given up its stored energy it and the pump come to rest. The diaphragm is not expanded as far downward as it was upward at the beginning of operations. This is because some of the energy originally stored in the diaphragm is lost in overcoming the friction of the system.



13 Capacitor discharges through reactor, feedback gives grid minus bias



14 Feedback gives grid a plus bias to charge the capacitor to full voltage

When conditions in Fig. 9 are reached the expanded diaphragm will reverse the flow in the system. The water motor will be reversed and the operations just described repeated. Unless energy is added to the system, flow oscillations will cease when the energy originally stored in diaphragm *D* has been expended in overcoming the system's friction.

After the first cycle when the motor has come to rest, assume valves *V* and V_1 are returned momentarily to their positions in Fig. 7. Diaphragm *D* will be deflected to its original position, en-

(*Continued on page* 118)

NO "FREEZE-UP"

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They installed Yarway Impulse Steam Traps on coal handling equipment. Now, though temperatures dip to zero and snows pile high, their traps never freeze.

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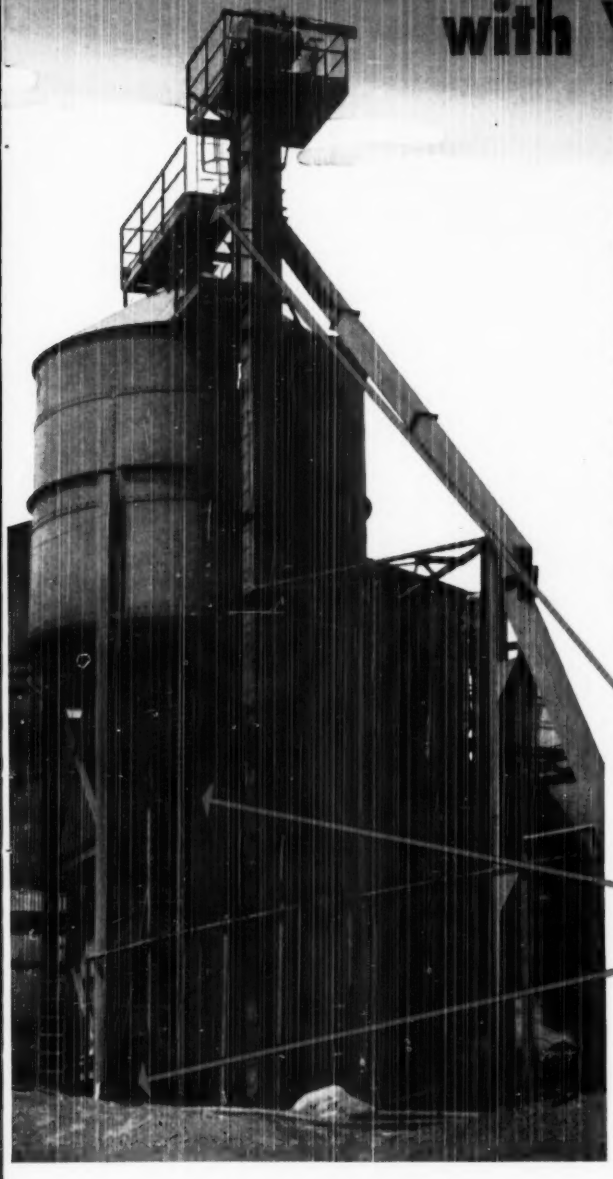
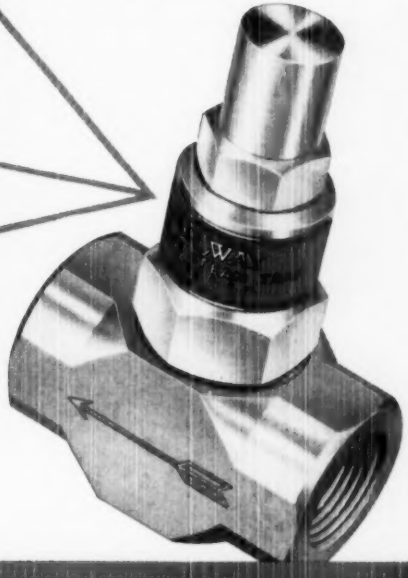


Yarway Traps best the worst weather in this installation at Thermoid's Trenton plant.

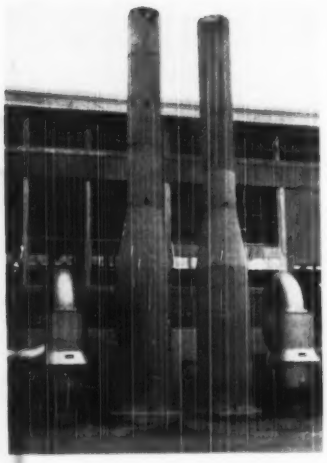


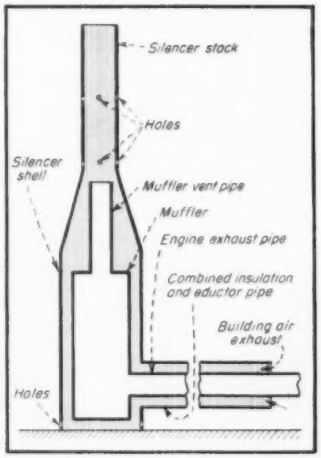
YARWAY **IMPULSE STEAM TRAP**

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

DRILLING HOLES SILENCES NOISY EXHAUST CONDITION





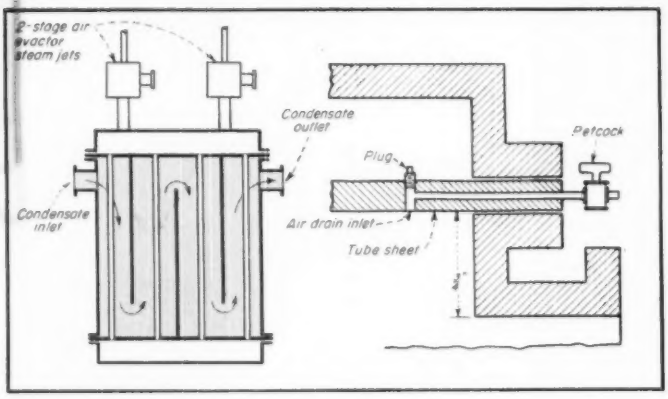
SOME DIESEL PLANTS house their mufflers to use the jet action of the exhaust to withdraw air from the building for ventilation. Sometimes this setup intensifies the noise instead of reducing it.

One plant that uses this arrangement eliminates the noise almost entirely by drilling 2-inch holes through the outer shell. Four holes were drilled at the base of the housing, four at the bottom of the stack, and another four halfway up, as the photo shows. Air entering through these relatively small openings cools the exhaust unit as well as breaking up the pulsations that cause the noise. The combined air and gas flow leaving the stack is effectively quieted.

The bottom holes also act as water drains during rainy weather.

ELTON STERRETT *Houston, Texas*

BLEEDING OFF AIR SOLVES LEAKING GASKET PROBLEM



WE HAVE a 2-stage steam-jet vacuum pump with a combined inter- and after-condenser. Left-hand sketch shows the general arrangement. Only one tube for each pass is indicated. Condensate, acting as cooling water for the steam-jet exhaust, flows through the channels formed by the baffles and around the tubes. Water pressure drops 20 psi in passing through the unit. For best operation water should fill the entire space in the condenser.

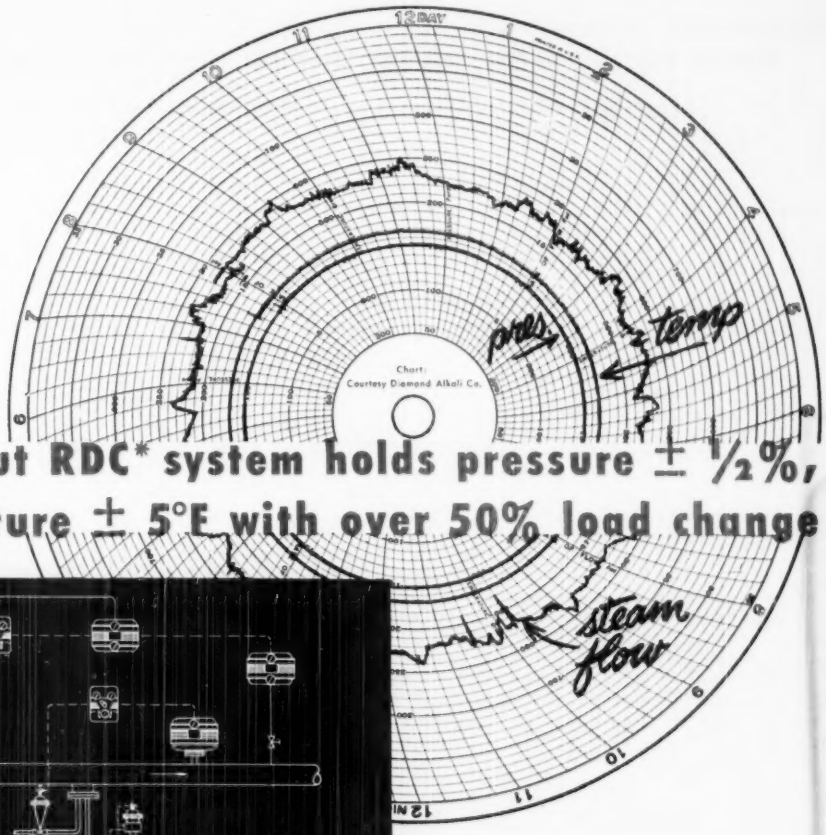
We experienced repeated leaks in the intercooler tube sheet just above the condensate outlet at the top of the last pass. Thinking the packing was at fault, we removed the original corset lace and replaced it with a plastic and fiber type. But a short time after installation this packing leaked just as badly and we were back where we started. Some other approach to the problem was needed.

We then studied the design of the condenser and found that since the top edge of the outlet was $\frac{3}{4}$ in. below the tube sheet, see right-hand sketch, an air pocket could easily form there. The pocket sat right at the area where the packing leaked. This allowed the packing to dry out, in turn letting water leak through.

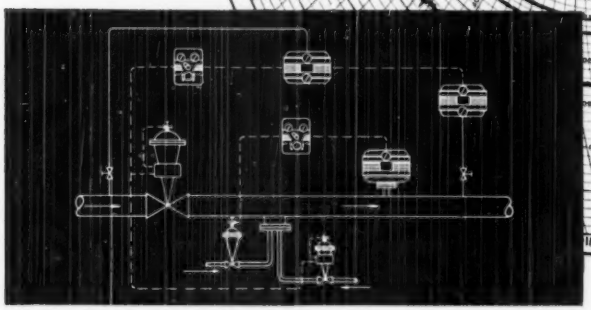
All that we needed was a method to bleed out this air. So we drilled a $\frac{1}{8}$-in. hole through the tube sheet, tapped the steam end and stopped it up with a plug. We then drilled a $\frac{1}{4}$-in. hole from the outer edge of the tube sheet to meet the $\frac{1}{8}$-in. vertical hole and fitted the outer end with a petcock. When starting up the unit the petcock is left open till condensate flows through it.

F HECKMAN *Boonville, Mo.*

(Continued on page 122)



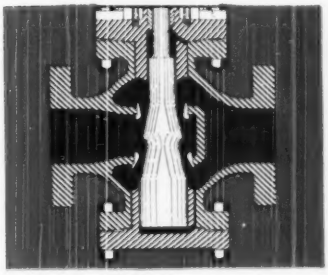
Swartwout RDC* system holds pressure ± ½%, temperature ± 5°F with over 50% load change



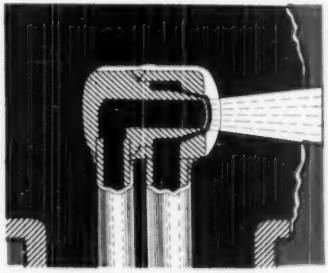
1 **RDC*—Reducing, Desuperheating and Control**—represents a single problem for which Swartwout assumes unit responsibility. Diamond Alkali Co. No. 4 RDC station at Painesville, Ohio, handles 200,000# steam per hour with reduction from 1450 to 152 psi; temperature from 900° to 438°F. Chart above shows the precision control of the Swartwout RDC system.

Swartwout

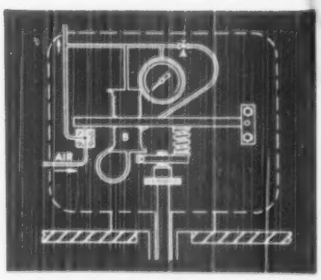
POWER PLANT EQUIPMENT



2 **REDUCING VALVE** for high pressure and temperature applications utilizes rugged construction and larger diameter stem to assure smooth action and long life. Disc and seat contours form nozzle-shaped passages which minimize turbulence and eliminate undue noise and life-shortening vibration.



3 **STEAM ATOMIZING** desuperheater has nozzle in center of steam line for effective narrow-angle dispersion of completely atomized water. Nozzle is accurately machined for each installation to give high velocity with existing atomizing steam pressure. Swartwout also makes carburetor and mechanical atomizing types.



4 **TEMPERATURE CONTROL** combines wide throttling range with automatic load compensation for close temperature control. Needle valve A adjusts rate of flow to and from reset bellows B, establishing load compensating characteristic. Operation is stable regardless of load change and time lag. A-5572

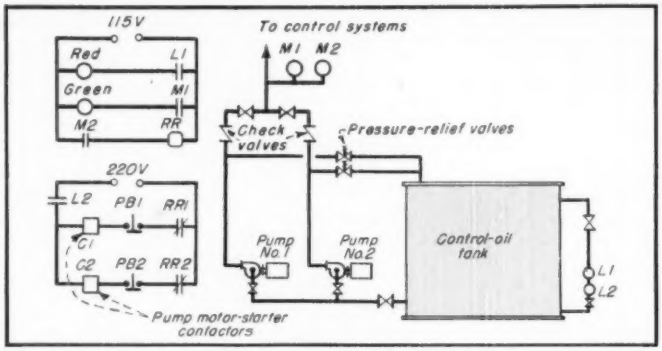
SEND FOR BULLETINS S-21-E, S-22-C, S-199. THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

POWER ENGINEERS' NOTEBOOK (*Continued from page* 120)

SAFETY HOOKUP KEEPS COMBUSTION-CONTROL SYSTEMS OPERATING

OUR PLANT has several combustion-control systems for heating and melting furnaces as well as for steam boilers that supply turbines. On many occasions the maintenance men found that service calls on control failures were caused by interruption of the power-oil supply. Oil pumps had stopped for some unknown reason, or the oil supply ran low because of someone's failure to check the reservoir level.

All the control systems were equipped with two pumps and a large supply tank. Servicing was an easy matter, but it meant the unit might be out of service for some time before a maintenance man could attend to it. To remedy these troubles the following three steps were taken.



First—check valves were installed on pump discharges as shown in the sketch. This enabled us to start and stop these pumps without manipulating valves also.

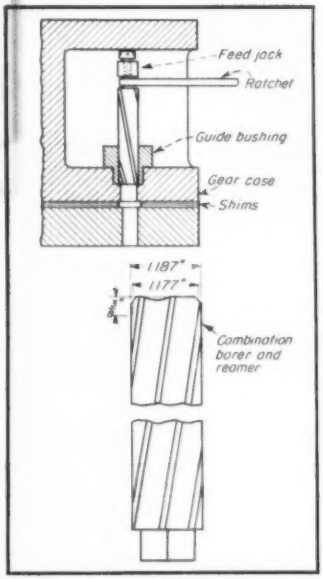
Second—two mercury low-water cutoff switches were installed on the oil tank, one about one-third the way from the tank bottom and the other about one-quarter up. The higher switch, *L1*, lights a red lamp on the operating floor where every operator can see it. The lamp is labeled and operators can fill the tank or call a service man for the job. The lower-level switch, *L2*, stops the pumps when oil level reaches this point. This prevents damaging the pumps or an excessive loss of oil in case of a major leak in the system.

Third step—two mercury pressure switches were installed on the pump discharge header and tied into the control and alarm system as shown in the sketch. One mercury switch, *M1*, is connected in series with a green lamp on the operating floor to warn operators of pressure loss. The other switch, *M2*, is connected in series with a ratchet relay. Loss of pressure causes the relay coil to be energized. This moves the ratchet on the relay to open *RR1* and close *RR2*. This closes the motor-starting contactors *C2* for pump No. 2, and opens No. 1 contactors *C1*.

Entire cost was about $50 for each installation. The job has been in service for over 10 years with no trouble in any respect. It has more than paid for itself.

C F BLACK *Cleveland, Ohio*

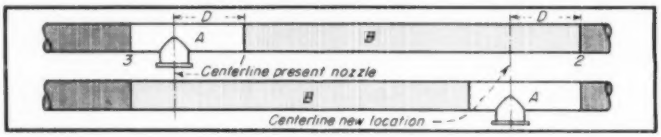
COMBINED REAMER AND BORER WORKS IN TIGHT SPOT



THE TOOL SHOWN in the sketch was used to bore and ream in one operation. It had to work on some dowel holes in a very tight location. We had to realign a large gear case that had been doweled with 1⅛-in. dowels. With the new alignment the old dowel holes were so much out of line, it was necessary to use larger dowels, 1 3/16 in. We had only 6-in. headroom for drill and reamer. We took a 1 3/16-in. straight reamer and ground the end to act as an end cutter by reducing it 0.010 in. in diameter. This tool saved grinding down an expensive drill, and enabled us to bore and ream in one operation in a very tight spot. To steady the reamer while working it was necessary to use guide bushings, upper sketch, left.

F J HERZINS *Tyrone, Pa.*

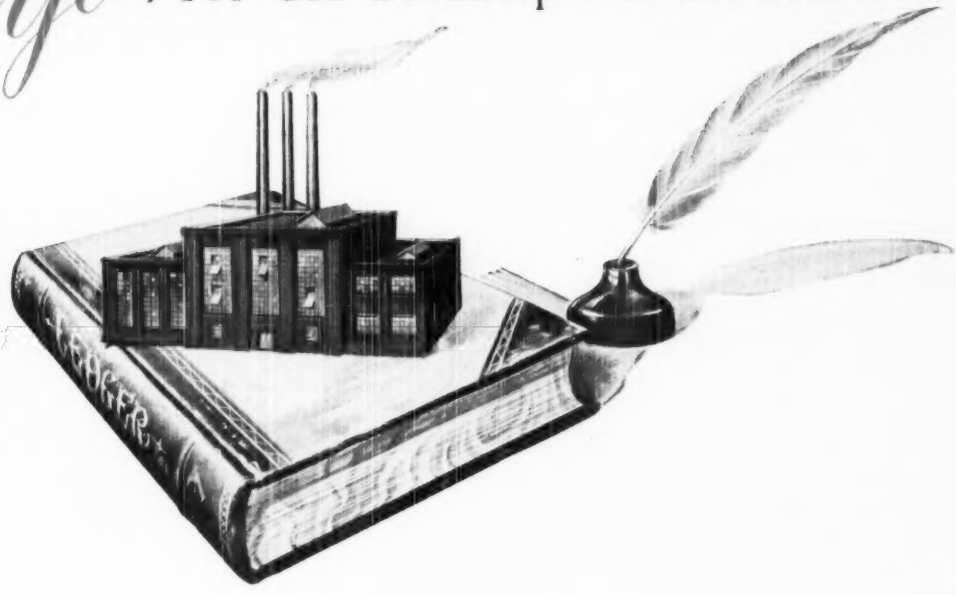
HOW TO CORRECT PIPING ERRORS QUICKLY



TO MOVE THE NOZZLE to a new location in the pipe run above: (1) Make cuts 1 and 2 at distance *D* from each center line. (2) Make cut 3 at any convenient place on other side of nozzle. (3) Interchange pipe lengths *A* and *B* and weld into final location.

R DIJULIO *Chicago, Ill.*

Yes, You Can Bookkeep a Boiler Plant!



The economic advantage of a correct and complete water conditioning service in your boiler plant can be readily figured. It is a sum of savings effected through elimination of the many unnecessary shut-downs directly traceable to an inefficient water treatment.

Efficient water conditioning starts with the raw-water supply and continues through the plant, taking in many problems. Trouble-free operation is a result of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical.

Our nationwide staff of engineers will welcome the opportunity of discussing with you this important subject of water conditioning . . . W. H. & L. D. BETZ, Gillingham and Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

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PROBLEMS FROM THE PLANT

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

WHAT CAUSES VACUUM DROP ON LOADED TURBINE EXHAUST?

WE ARE RUNNING INTO a tough vacuum problem on one of our steam turbines. Before going into detail I might mention the turbine in question is designed for 225-psi steam. We operate at 250 psi, superheated to 560 F. Turbine discharges direct to a condenser having 13,725 sq ft of surface.

Circulating pump in the condenser circuit handles 14,000 gpm and is powered by a 200-hp motor. Looking at the electrical side of the picture, the 10,000-kw 3-phase generator runs at 1800 rpm and feeds into the 11-kv 60-cycle station bus. Incidentally, air is removed by a double-stage air-jet pump. Average barometric pressure in the plant is about 25.5 in. Hg.

And now for the problem. We notice a big drop in vacuum when the electrical load reaches between 5000 and 8000 kw. At the latter load the vacumm drops to 12 in.

Our first checking point was the vacuum pump. We have tested this separately, along with hydrostatic tests on the condenser, and all seems to be OK. With the generator running at no load, vacuum is about 24.5 in. At 3000-kw load, vacuum drops to about 23 in. Then as load increases we notice a progressive drop till 12 in. is reached at 8000 kw.

We're at a loss for the reason. Perhaps some POWER readers can come to the rescue.—*LM*

READERS' ANSWERS

Can Auto Engine Be Converted to Air Compressor?

(This question is from October issue with best answers from readers.)

Several old automobile gasoline engines have been knocking around our plant for the past few years. We want to put them to work. We have no immediate need for an engine, but we could put an air compressor to good use. What we want to do is convert one of the auto engines to an air compressor.

If this can be done, our first load will be a jackhammer that takes about 100 cfm at 100 psi. We are not sure whether it would be best to (1) run the engine as a combination engine and air compressor, by using several of the cylinders as the compressor, or (2) convert the engine completely to an air compressor.

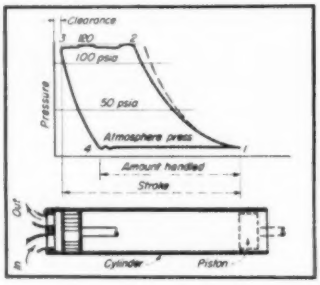
After reading many of the answers that POWER *readers have sent in to past questions, I am sure they will get me started on the right track. I might add that we have all the tools and mechanical skill necessary to make any changes.*
—*CK*

Figuring Compressor Load

A GASOLINE ENGINE can be converted to an air compressor. In a 4-cycle engine the piston operations are: admission, compression, power and exhaust. This cycle of operations is accomplished during the four strokes of the piston or two revolutions of the crankshaft.

First two operations are similar to that of a reciprocating compressor. Hence two strokes of the piston or one revolution of the crankshaft is necessary to complete a cycle.

CK can convert some of the engine cylinders to do the compression job, leaving the remainder to do its usual work as an engine. This will require that certain adjustments be made on the camshafts operating the inlet and discharge valves of the converted cylinders.



On the other hand, *CK* can convert the engine completely to an air compressor. In that case another engine will be needed to supply the motive power for the converted compressor. Which of these alternatives should *CK* choose? To answer this question we must find out how many cylinders will be required to supply the 100 cfm of air for the jackhammer and how many power cylinders are required to supply the hp demand.

To advise the exact number of cylinders needed for his 100-cfm load we would have to know: (1) size of bore and cylinder dia (2) length of stroke and (3) engine hp and rpm. Nevertheless, we can generalize. Then *CK* may adapt these generalizations to his specific case.

Assume his engine has a capacity of Z horsepower and n cylinders. Then the quotient, $Z \div n$ is the hp per cylinder. Now let us find out how many hp he needs to deliver 100 cfm at 100 psi. This will tell us how many cylinders we need to supply the required hp.

In sketch at left, piston is at the stroke end. In clearance space the compressed air is at a discharge pressure, p_2. The piston is about to move to the right or down, as the case may be. Compressed air follows the piston and expands to slightly below atmosphere pressure, p_1. At this point, air from outside rushes into the cylinder until the piston reaches the end of its stroke, shown dotted.

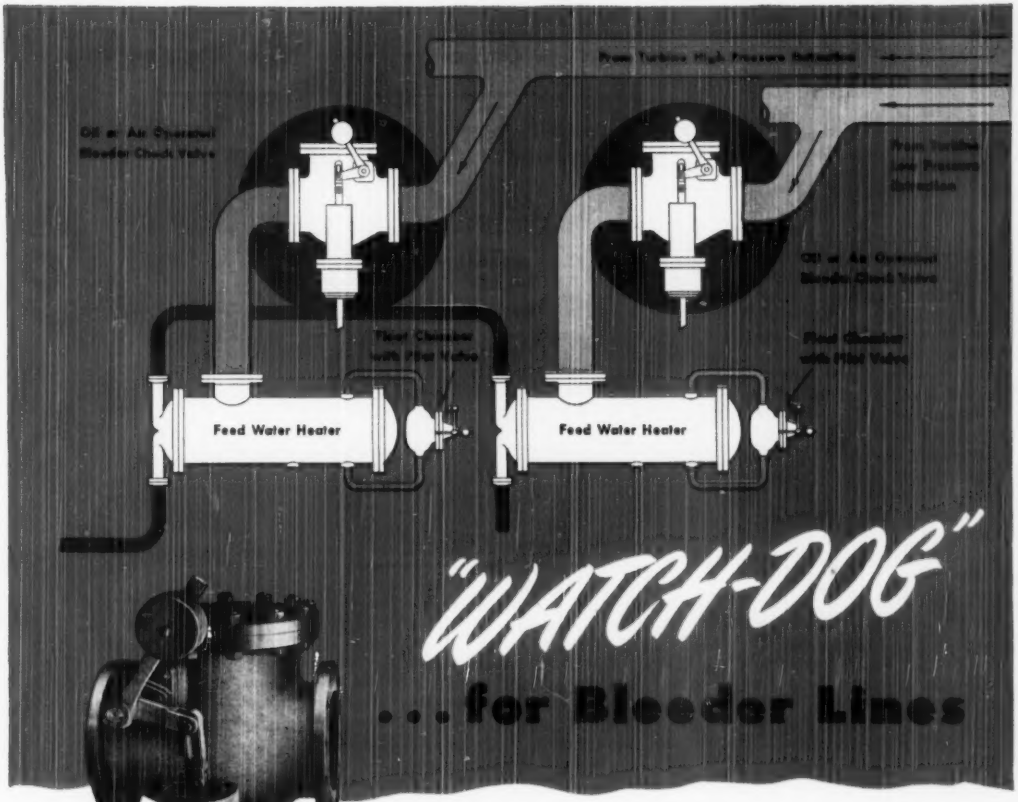
Now the inlet valve closes and an amount of air, less than the capacity of the cylinder, has been trapped. Exact amount of air must be determined by test. The piston starts on its compression stroke compressing the air to a pressure higher than *CK*'s jackhammer requires (say, $105 + 14.7 = 119.7$ psia). This gives a compression ratio of 8 : 1. His engine has a ratio of 6 : 1. Therefore, he must decrease the clearance to raise the compression ratio.

He can do this by putting a plate (shim) on the piston or adding a disk on the inside head of the cylinder under consideration. Here's how to compute amount of air handled by one cylinder:

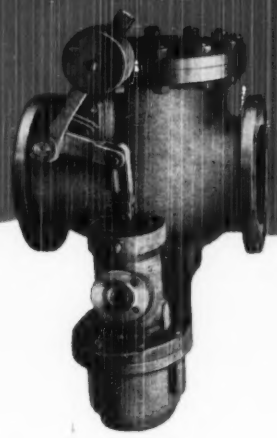
$$(0.7854\ D^2 \times L \times N) \div 1728$$

cim per cylinder.

D is the bore in inches. L is length



"WATCH-DOG" ...for Bleeder Lines



GUARDING expensive turbines from bleeder back-flow damage demands a check valve that works *every* time. That's why it pays to come to specialists in power equipment for the valves to fill your "watch-dog" chores.

In the installation above, the turbine bleeder line supplies low-pressure steam for boiler feed water heating. The oil or air operated Swing Check Valve in the bleeder line gives *positive* protection against back flow of condensate, water leakage, or low-pressure steam. The valve's full-flow design and precision seating give a bonus of efficiency and lower pressure loss.

The SK Bleeder Line Check Valve is typical of the *standard* power equipment which Schutte and Koerting has been manufacturing for over sixty years. In addition, SK engineers stand ready to help you with your *unusual* power control problems —by either adapting *standard* items, or engineering *special* equipment to fit your job.

Write for Bulletin 8-K on SK Bleeder Line Check Valves, or for engineering assistance on your special power problems.

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of stroke in inches, N is engine rpm (probably 3500 or 4000). Expressing the engine rpm in thousands, the above formula takes the form:

$$0.45\ D^2 \times L \times N \qquad \text{(cfm)}$$

Here N = 3.5 or 4, as the case may be.

However, since the actual amount of air handled is less than that computed, we must multiply the above by an amount less than unity, say, 0.8. This gives the final formula *CK* should use as: $0.36\ D^2 \times L \times N$ cfm. Let this answer be *C*. If *C* equals 100, he needs but one cylinder to convert to a compressor. But if *C* is less, he must calculate the number of cylinders required.

To make the valves operate correctly the camshaft must be changed. Cam or cams taking care of the converted cylinders should have two high spots only. They should be located 180 deg apart. One of these high spots will operate the inlet valve, the other the discharge valve.

J YAVITCH *Philadelphia, Pa.*

Well, Perhaps . . .

IT IS GENERALLY not practicable to convert automobile engines to air compressors. I have seen a number, and they were generally not satisfactory. Moreover, the cost was equal to or greater than that of a new compressor.

One exception to this is the Ford V-8 motor. I understand one manufacturer makes conversion parts for these motors that are quite successful. With the proper parts, one bank of cylinders may be used as an engine, while the other is a compressor.

G W BENEDICT *Montpelier, Vt.*

EDITOR'S NOTE: Mr. Benedict mentioned the name of a manufacturer in his original letter. This company's name and address may be had by dropping a note to the Plant Problem's Editor, c/o POWER.

Some General Advice

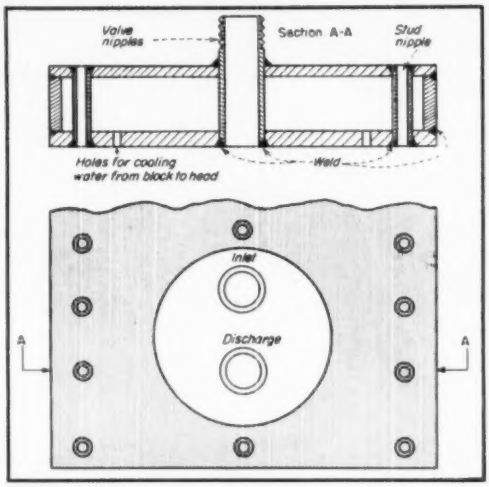
CONVERTING A GASOLINE ENGINE to combination engine and air compressor is quite a tedious job. Best way to go about it is first to strip engine of all unnecessary equipment. Make provision on camshaft so exhaust and intake opening and closing time is fixed in relation to piston movement. Thus every downstroke will be a suction stroke and every upstroke a compression stroke. Needless to say, the exhaust valves then become air-discharge valves. If engine exhaust manifold is not strong enough to withstand strain and pressure, discard it and make one out of pipe nipples. Also, incorporate a check-valve adaptable for air service, between manifold and air receiver.

Another possibility is to insert suction valve, consisting of several steel disks, in the top of the piston. Then discontinue the camshaft drive that actuates the intake and exhaust valves. Keep all valves in a closed position at all times. Pistons will then receive their suction air via the crankcase, discharging the compressed air through the spark-plug opening. Provide each spark-plug or air-discharge opening with a check valve before combining the discharge openings to manifold or header.

A far less time-consuming method would be to rig the cylinder head with two openings or holes for each cylinder—one for suction and one for discharge. It may be wise to enlarge the spark-plug opening and insert a nipple and T-fitting. This will handle suction and air discharge through one opening for each cylinder. Here again the valve camshaft operation must be discontinued.

(Continued on page 160)

Here's a Rough Outline to Follow When Tackling Job



IT WILL BE TOUGH to get a smooth firing-order on power cylinders if the gasoline engine is rigged up for a dual job. On top of that, an engine operates best with its water temperature reasonably high while an air compressor favors a lower water temperature.

Here's the procedure I recommend *CK* follow in fitting all cylinders of one engine for air-compressor duty. Incidentally, the L-type engine head, or one that has piston travel to the top of the cylinders, is best adapted for this job. Clearance volume can then be reduced to gasket thickness.

Since tools and mechanical skill are available, the first job is to replace the present cylinder head with a new head fabricated as shown in above sketch. Weld pipe nipples into the head so original studs can be reused. Provide for circulating water from block, to head, and then to an outlet.

Control welding heat to reduce warping. And when the welding job is completed, machine the head facing cylinders. After that, install vertical check valves for suction and discharge. Locate these valves close to head to reduce clearance volume.

Then pipe the inlet lines to a manifold, not forgetting an air cleaner. Run discharge lines to a water-jacketed manifold for after-cooling before the air enters the receiver. And, of course, the crankshaft, valves, intake and exhaust manifolds along with the ignition system should be removed.

If plant water is used for cooling, the radiator, water pump and fan can be eliminated. Have water enter the compressor cylinder jacket first, then through the cylinder head to the aftercooler. At that point the water temperature will have been raised, making it quite suitable for cooling engine cylinders.

The job can be wrapped up by installing adequate safety valves and a receiver drain. Any combination of controls can be incorporated for loading and unloading compressor and throttling engine.

R E FONTAINE *Kenmore, N.Y.*

For special conditions:

Anaconda Duplex Tubes

ANACONDA Duplex Heat Exchanger Tubes on request are supplied with the ends of the external tube cut back to receive ferrules for rolling into the tube sheet. Ferrules can also be supplied.

ANACONDA Duplex Tubes are available in a wide range of metals. These tubes can be supplied with the copper or copper alloy drawn either inside or outside of the steel tubing. For example, in a diethanolamine stripper, a copper-steel combination is called for, with copper on the outside of the tubes to resist corrosive steam and steel on the inside to resist attack by the amine.

For general information on ANACONDA Duplex Tubes write for Publication B-2. And remember that ANACONDA metallurgists are always ready to help you solve your tube problems. Address The American Brass Company, Waterbury 88, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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For efficient heat transfer

ANACONDA Heat Exchanger Tubes

TECHNICAL BRIEFS

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REVIEWED IN THIS ISSUE

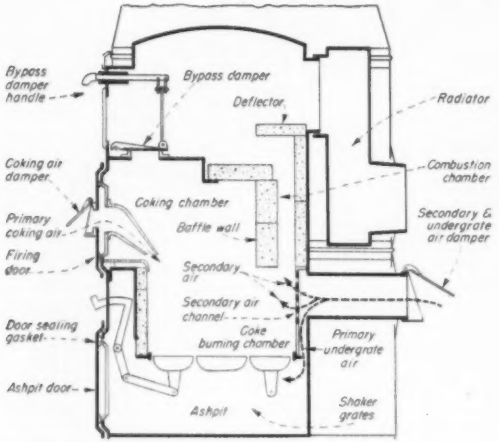
ELECTRICITY: Performance of Topped Steam Power Plant on Sudden Load Reductions • New Automatic Load Control for Turbine-Generators • Relation of Thermal Plant Design to Reserve-Capacity Requirements • Governors and the AIEE-ASME Performance Specifications

FUELS AND FIRING: Laboratory and Home Performance of the Illinois Smokeless Furnace

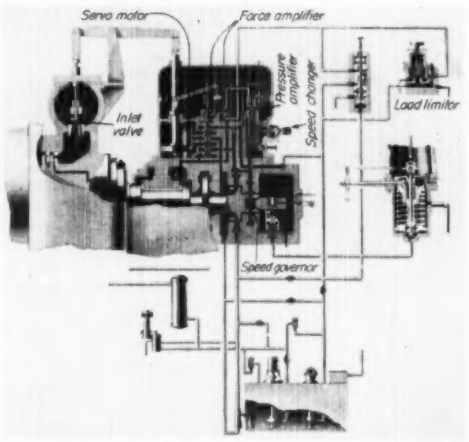
LUBRICATION: Density-Pressure Relationships for Two Low-Viscosity Dimethyl Siloxanes

WATER TREATMENT: Industrial Approach Toward Waste-Water Treatment and Stream Pollution • Chemical Quality of Industrial Surface Waters of Pennsylvania • Water Problems in Starting Mitchell Power Station • Problem of Generating Pure Steam at High Pressures

Directions for ordering papers are given on page 130



1 Vertical cross section of new smokeless domestic furnace labels principal parts in unit using down-draft principle



2 Details of a hydraulic-type speed-governing system for a turbine shows components in performance specifications

ELECTRICITY

PERFORMANCE OF A TOPPED STEAM POWER PLANT ON SUDDEN LOAD REDUCTION, *by J G Noest, Consolidated Edison Co of N. Y.* Most of the load on the Sherman Creek Station comes from a single high-tension tieline. Trip-outs of this line cause severe unloading of the station. Study and tests were run to determine performance under these conditions of (1) local electrical system (2) turbines (3) steam generators.

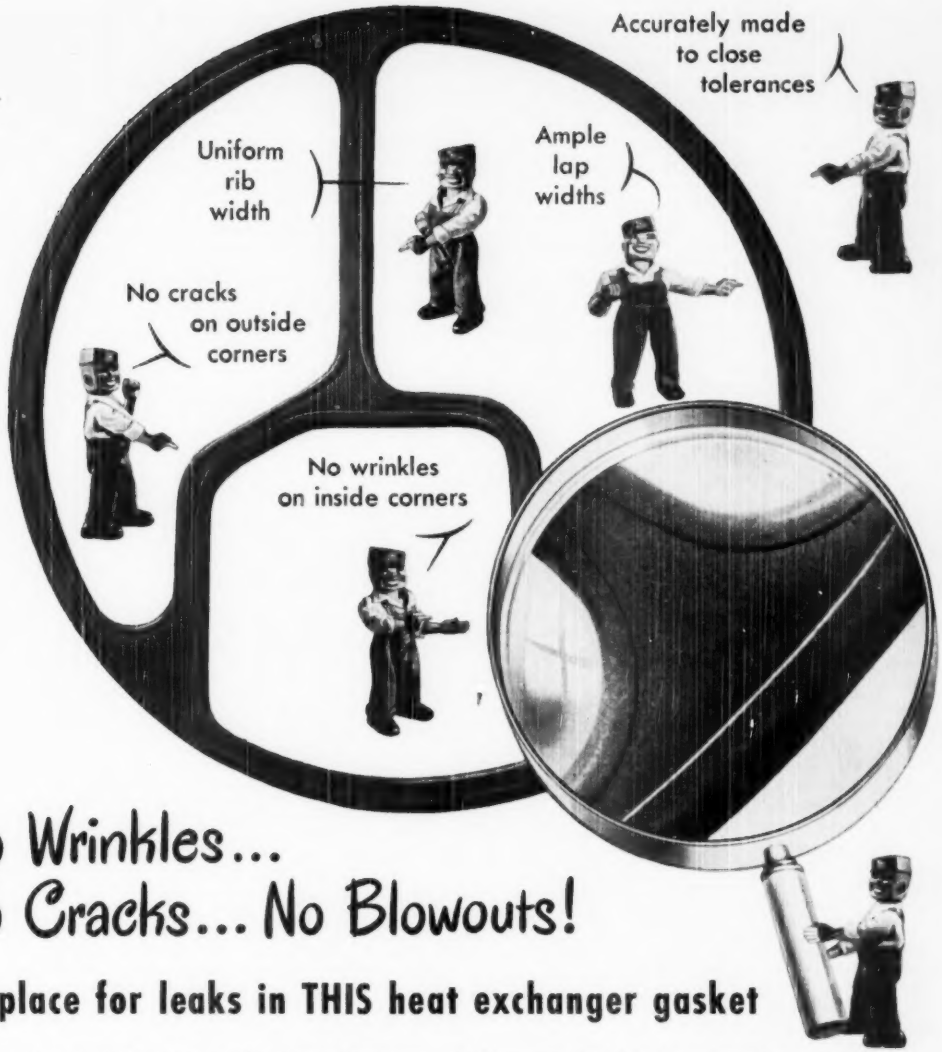
Studies that were closely checked by tests showed that frequency rose by about 4.5% upon load losses ranging from 50 to 170 mw. Bus-voltage rise varied from 15%, for the lower load losses, to 24%, for the higher. The faster governors of the topping units are primarily effective in limiting frequency rise. Low-pressure steam storage helps reduce the rate of l-p steam-pressure change. Judicious removal of excess generating capacity is the quickest way for restoration of normal conditions.

The following operating guides were worked out for the station operators: Electrical operators must know which units to drop for each load condition. Their plan of action must be agreed to by turbine and boiler operators. All must keep informed of changing conditions. In general, the electrical operator will (1) trip off preselected units promptly (2) reduce frequency as needed by lowering load on heaviest loaded units (3) reduce voltage by lowering excitation beginning with lightest loaded units, and maintain lagging power factor (4) in reducing load be guided by low-pressure header pressure and by motoring limitations on topping units.

At the same time, the turbine operator secures all units tripped by the electrical operator and prepares them for resynchronizing as needed. The boiler operator switches from automatic to manual control on combustion and feedwater. He secures all h-p boilers tripped out in a normal manner. A heavy coal feed is kept on the bottom burners of the remaining h-p boiler to prevent loss of ignition. Ignition torches are cut in immediately. All coal feed is cut off if water level drops below the danger point. L-p boilers are cut into service and forced to steaming rate as needed. *AIEE paper No. 49-291.*

A NEW AUTOMATIC LOAD CONTROL FOR TURBINE-GENERATORS, *by H B Ruud, Iowa-Illinois Gas and Electric Co, and S B Farnham, General Electric Co.* Addition of an Aluminum Co of America rolling mill on the Iowa-Illinois Co system will add a 40,000-kw peak load on a system carrying 100,000-kw maximums. In addition, this load will swing by about 16,000 kw in, roughly, one-minute intervals.

To base-load the tielines from the Riverside Station (which will carry this


Accurately made to close tolerances
Uniform rib width
Ample lap widths
No cracks on outside corners
No wrinkles on inside corners

No Wrinkles... No Cracks... No Blowouts!

no place for leaks in THIS heat exchanger gasket

TAKE A CLOSE LOOK at the Goetze heat exchanger gasket shown above. Note the absence of cracks on outside corners . . . of wrinkles on inside corners . . . the uniform width of the ribs . . . the generous overlap of the metal jacket.

Attention to such important details is typical of the kind of care that goes into the forming of these custom-made gaskets. It is the secret of their dependable service—why you can count on them to stay on the job indefinitely without leaks or blowouts. And it's the reason they pay off in terms of less down-time and in the savings that result when gaskets *don't* have to be replaced at frequent intervals.

• • •

You can have Goetze heat exchanger gaskets made in any size or shape. Estimates and recommendations will be furnished promptly on request. Write Johns-Manville, Box 290, New York 16, N. Y.

JM PRODUCTS

Johns-Manville *Goetze* Gaskets

load) to other stations in the interconnected system, the load fluctuations must be carried by Riverside. This will be done by special arrangement of the usual speed-governing controls on two of the four units in the station. The synchronizing motor on these units will be oversized to provide travel time of 4 to 5 sec from open to close as compared with the usual 20 to 30 sec. This will help force the controlled turbine-generator to assume the local-load fluctuation in advance of the tendency of fluctuations to change system frequency.

The synchronizing motor is a separately excited dc shunt motor instead of the usual split series-field motor. A follow-up arrangement develops a voltage output proportional to the speed-changer lead screw position. This is done by a Selsyn operating as an induction voltage regulator. To prevent possible water carryover from the boiler a steam-pressure regulator exerts an overriding control in case of excessive pressure drops below 750-psig total pressure.

Current in the feeders supplying the mill operates the automatic load-regulating control. The totalized current produces a voltage drop across the resistor of a bridge circuit. Any current in the feeders unbalances the bridge, causing an amplidyne generator to produce a dc voltage rotating the synchronizing motor in the proper direction to adjust unit output in accordance to variation in demand. Once the turbine-generator satisfies the new load needs, the voltage from the follow-up device reestablishes the balance of the bridge. The amplidyne generator output voltage returns to zero and the synchronizing motor comes to rest. Generator output follows the mill load demands within one to 1½ sec. At this rate the load swings do not cause measurable change in system frequency. *AIEE paper No. 49-289.*

THE RELATION OF THERMAL PLANT DESIGN TO RESERVE CAPACITY REQUIREMENTS, *by M J Steinberg, Consolidated Edison Co of N. Y.* While the present-day trend to single-boiler single-turbine station design results in minimum investment cost for the individual plant, from the system-wide standpoint, investment in total capacity may be excessive. Other factors strongly influencing installed capacity are (1) accidental or forced outages to be guarded against and (2) provision of standby capacity for overhaul periods.

Connecting boilers and turbines through common steam headers reduces the amount of system reserve capacity needed. Installing reserve boiler capacity on a common steam header raises plant availability and reduces the need for system reserve. These factors can be demonstrated by applying the probability theory and assuming that a given level of reliability will be acceptable for alternate schemes.

In reheat-regenerative cycles, common steam headers are not practical. The gain due to increased economy from this cycle compared to single-unit straight-regenerative cycle is equivalent to about $6 per kw justifiable additional investment for reheating. This is less than for some layouts using common steam headers. *AIEE conference paper.*

GOVERNORS AND THE AIEE-ASME GOVERNOR PERFORMANCE SPECIFICATION, *by A F Schwendener and Wayne Astley, Westinghouse Electric Corp.* The joint AIEE-ASME Committee on a recommended specification for prime-mover speed governing recently issued its suggestions. Included were definitions and descriptions of terms relating to governor functions and performance standards.

This paper shows the application of these terms and definitions to modern speed-governing systems. It also indicates how these systems meet the requirements of the specifications.

Two basic speed-governing types receive considerable attention. One contains features common or comparable to most flyball governing designs. The second is an oil-governing system. Fig 2, p 128. All components, grouped under proper terms, are put together in table form. In a similar manner the components of an electronic governor can also be listed.

The author then describes the operation of each system as a whole so the function of the components can be understood. As he describes the role of the component part he points out how it compares with the suggested specification of the joint committee.

Operating conditions and requirements selected for discussion are: (1) steady-state speed regulation (2) steady-state incremental speed regulation (3) dead band (4) stability and overspeed (5) range of speed-change adjustment (6) adjustment of speed regulation with turbine in operation (7) load-limiting device. *AIEE paper No. 49-288.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources:

American Society of Mechanical Engineers, annual meeting, New York, N. Y., Nov 28-Dec 1, 1949. Papers are identified by initials ASME. Obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers, fall general meeting, Cincinnati, Ohio, Oct 17-21, 1949. Papers are identified by initials AIEE. Obtainable through AIEE, 29 W 39th St, New York, 18, N. Y.

Engineers' Society of Western Pennsylvania, annual meeting, Pittsburgh, Pa., Oct 17-19, 1949. Papers are identified by initials ESWP. Obtainable in proceedings at $7.50 from W M Porter, secretary, ESWP, William Penn Hotel, Pittsburgh, Pa.

FUELS AND FIRING

LABORATORY AND HOME PERFORMANCE OF THE ILLINOIS SMOKELESS FURNACE, *by J R Fellows, Univ of Illinois, and John W Norris, Lennox Furnace Co.* Extensive laboratory and field experience have gone into the development of smokeless domestic furnaces. This paper presents a digest of much of this information as it pertains to the unit described, Fig. 1.

The authors presume the audience is familiar with basic principles of smokeless combustion. They refer freely to papers previously published on these principles.

Some new problems in draft regulation as they affect the new design are discussed. The various devices developed to solve these problems come in for some study.

Given is a summary of indoor and outdoor temperature data for a continuous period covering one half of a complete heating season. From this data it is concluded that many private homes can operate a smokeless furnace of reasonable size with only once-a-day attention. *ASME paper No. 49-A-28.*

LUBRICATION

DENSITY-PRESSURE RELATIONSHIPS FOR TWO LOW-VISCOSITY DIMETHYL SILOXANES, *by S B Gunst, Gulf Research & Development Co, and University of Pittsburgh.* The dimethyl siloxanes are members of the group frequently called silicones. They are heat stable, chemically inert compounds. Their stability and small viscosity-change with temperature suggest their potential excellence as viscometer-calibration standards, the objective which prompted this investigation.

In the rolling-ball viscometer, an instrument used for the determination of absolute viscosities of fluids at elevated

(*Continued on page 151*)

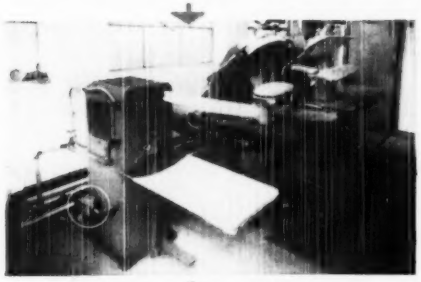
"How to get new steam traps for free"

Trade steam losses for them . . .

Cost of Steam Leaks at 100 Pounds Pressure

(Assuming steam costs 50 cents per 1000 lbs.)

Size of Orifice	Lbs. Steam Wasted Per Month	Total Cost Per Month	Total Cost Per Year
1/2"	835,000	$417.50	$5,010.00
3/8"	470,000	235.00	2,820.00
1/4"	210,000	105.00	1,260.00
1/8"	52,500	26.25	315.00
1/16"	13,200	6.60	79.20
1/32"	3,400	1.70	20.40



Saves $59.62 MONTHLY — $98 for Armstrong Steam Traps cut the fuel oil consumption at *Wisconsin Cleaners*, Milwaukee, from an average of 1167 gallons per month down to an average of 625 gallons per month. The traps were better than "for free" — they pay back their purchase price more than seven times every year!

IT COSTS far more to live with leaky steam traps than it does to replace them with Armstrongs — the traps that pass no steam. Measure their cost against steam losses caused by traps that let steam get by (see left).

In Armstrong traps the discharge valve is water-sealed at all times—no steam gets to it. There's no chance for dirt to hold the valve open and let steam escape. Armstrong traps don't COST money, they SAVE money. Ask your nearby Armstrong representative to figure on the traps you need now.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.

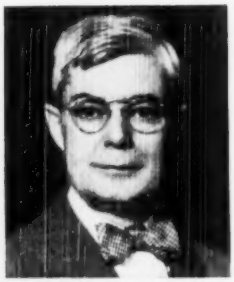
SEND FOR THE STEAM TRAP BOOK. It tells how to figure condensate loads, how to select traps. Includes prices, data, capacities of Armstrong Steam Traps. Write for your copy.

ARMSTRONG STEAM TRAPS

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

JAMES D CUNNINGHAM, president Republic Flow Meters Co, becomes president of American Society of Mechanical Engineers



F M GUNBY, associated with C T Main, made regional v-p

J C REED serves as regional vice-president, Region III

A C PASINI, Detroit Edison, also regional vice-president

T E PURCELL, supt, Duquesne Light Co, director-at-large

ASME Officers Take Over

► THE SEVENTIETH ANNUAL MEETING of the American Society of Mechanical Engineers was run Nov 28 through Dec 2. Its theme was, "The Engineers' Contribution to a Peaceful World." There were 74 technical sessions and over 300 technical papers. At the close of this meeting the new officers, some of whom are shown on this page, took over their duties.

As is usual at the annual meeting, papers and awards covered the full range of mechanical engineering. In the field of awards the following men were singled out: Alex D Bailey, Fellow ASME, vice president Commonwealth Edison Co; D Robert Yarnall, Fellow ASME, president, Yarnall-Waring Co; Roy C Muir, Fellow ASME, vice-president and general manager of General Electric's apparatus dept. All received honorary memberships.

These men were recipients of medals: Fred I. Dornbrook, general consultant, power plant dept, Wisconsin Electric Power Co, the ASME medal; Fred B Seely, dept head, University of Illinois, dept of theoretical and applied mechanics, the Worcester Reed Warner medal; Harold B Maynard, president, Methods Engineering Consultants, the Melville medal; Arthur M Wahl, development engineer, Westinghouse Elec Corp, the Richards Memorial award; Philip S Myers, assistant professor of mechanical engineering at University of Wisconsin, the Pi Tau Sigma award.

The technical papers that apply to the power field will appear in POWER's Technical Briefs department from time to time beginning with this issue, p. 128.

EDITOR'S NOTE: For more news and the calendar of COMING EVENTS, usually appearing on this page, turn to page 192.

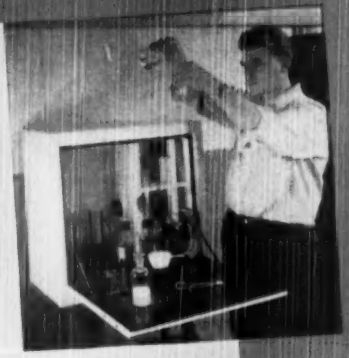
The speakers and their subjects were selected to present the most up-to-date information on important items by those in a position to speak authoritatively. The panel or symposium method of presentation featured many of the sessions. Several such sessions were: (1) Management: The Obligations Implied by Trusteeship (2) Railroads: American Railroads—Our Largest Materials-Handling Industry (3) Fuels and Power: Flyash Utilization.

While not a panel or symposium, a somewhat similar session was conducted on Furnace Performance Factors by the Research Committees of the Fuels, Power and Heat Transfer Divisions.

Along with the papers and awards were opportunities to visit several plants in New York City or its immediate vicinity: Public Service Elec & Gas Co, Sewaren, N. J. power plant; Worthington Pump & Mach Corp, Harrison, N. J. works; Waldorf Astoria Hotel; New York Times—newspaper; Tide Water Associated Oil Co, Bayonne, N. J.

THE *Nalco* SYSTEM OF WATER TREATMENT

Backs Your Routine Plant Testing....



with Scientific Laboratory Analysis

Spectrographic analysis of boiler water sample in the Nalco Laboratories.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place
Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario

NALCO System service does not stop with your original plant survey and chemical treatment recommendations . . . One of the principal reasons Nalco System plants *continue* to get water treatment results, year after year, is that Nalco field and laboratory service back routine plant testing and control procedures with careful analyses and regular surveillance of all conditions relating to your overall water treating problems.

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COMPLETE LINE *of* JENKINS Stainless Steel VALVES

Built to the same quality standard that makes any Jenkins Valve your best buy.

You know it pays—and pays well—to use Jenkins Bronze, Iron and Steel Valves. In industry after industry, these valves bearing the famous Diamond trade-mark have set records for long, trouble-free service and low upkeep cost.

You'll find the same Jenkins quality built into Jenkins Valves of Stainless Steel. Service records show many years of faultless operation in the control of highly corrosive fluids, and liquids which may become contaminated or discolored by contact with other metals.

More and more Stainless Steel Valves have been added to the Jenkins line as the need has developed in such industries as food processing and packing, chemical, textile, petroleum, pulp and paper, and rubber. Today it includes Gates, Globes, Angle, "Y" and Check Valves in a range of sizes to answer practically all requirements.

A new data folder just off the press, describes the complete line of Jenkins Stainless Steel Valves, and contains valuable information on selection of the proper alloy for the service.

JENKINS BROS. 80 White Street, New York 13, N. Y.
Please send Stainless Steel Valve Folder Form 194

NAME _____

COMPANY _____

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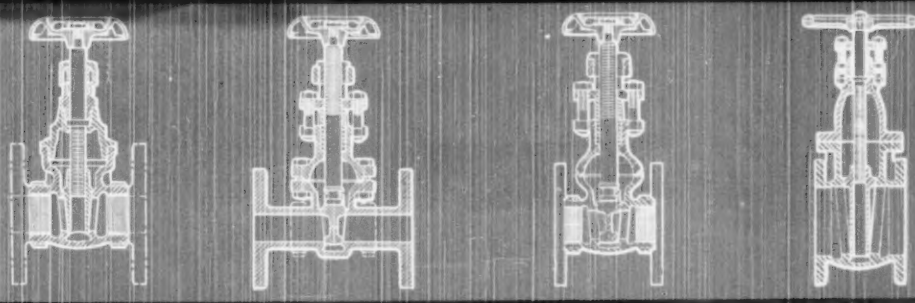
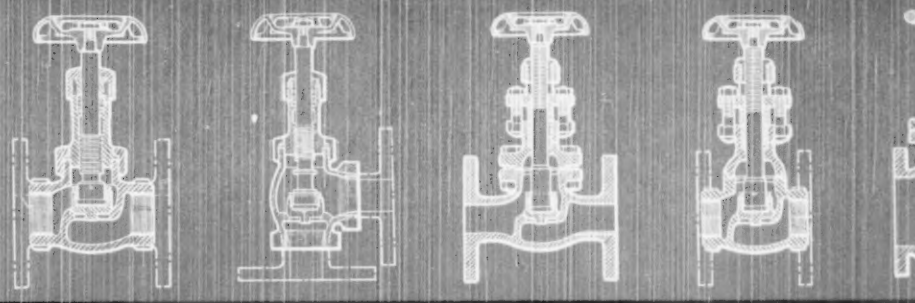
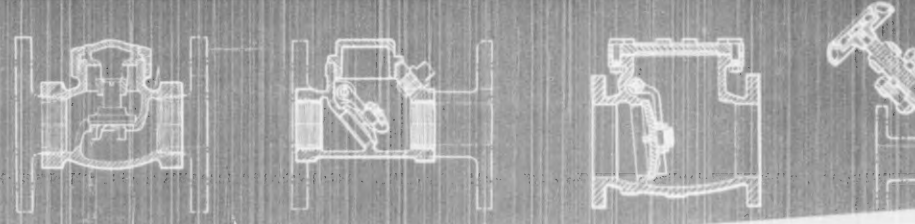






If your plant handles corrosive liquids, or fluids that must be kept absolutely free from contamination or discoloration, you will want this new Data Folder. It will help you select the *right* Stainless Steel Valve for your requirements. Write for a copy today. Use the coupon.

Jenkins Bros., 80 White Street, New York 13, N. Y.
Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago; San Francisco. Jenkins Bros., Ltd., Montreal

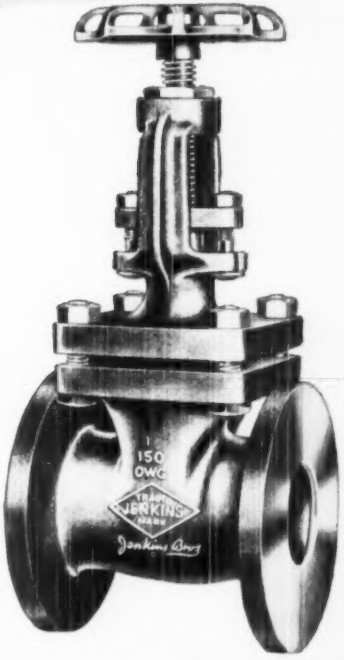
Sold through leading Industrial Distributors everywhere

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 TRADE JENKINS MARK

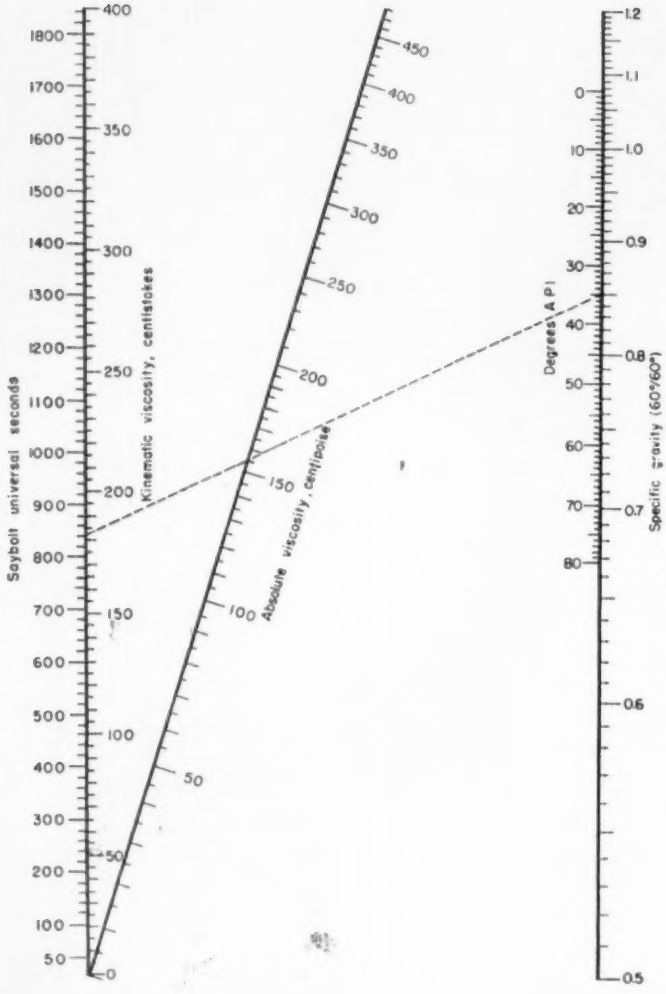
Jenkins Bros.



POWER'S DATA SHEETS

Number 211

Handy Viscosity Conversion Chart

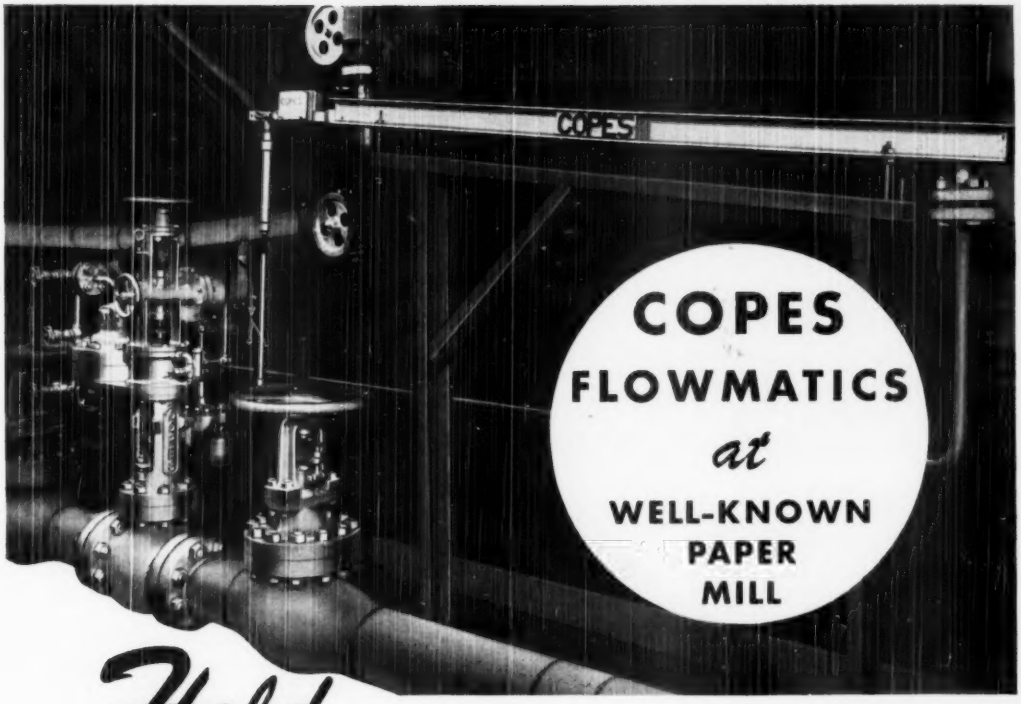


► Oil viscosities may be measured or given in any number of systems. Saybolt universal seconds are the commonest units used in America. They are measured by a commercial instrument known as the Saybolt viscosimeter. The relation of these units to those measured by basically scientific instruments depends on the temperature at which the oil is measured.

The nomogram is based on the relations for 100-F oil temperature as given in the American Society of Testing Materials Standard, Designation D446-39. This relates Saybolt universal seconds to the kinematic viscosity in centistokes. Relation between kinematic and absolute viscosities depends on the oil's specific gravity. This may be found by comparing the weight of a volume of oil with that of an equal volume of water when both are at 60 F. It may also be found by a hydrometer graduated in API degrees.

Example: An oil having a specific gravity of 0.85 at 60 F has a viscosity of 840 Saybolt universal seconds when heated up to 100 F. Find its kinematic and absolute viscosities. Lay a straight edge between the corresponding intersections on the left- and right-hand scales and find 182 centistokes kinematic viscosity, 155 centipoise absolute viscosity, and 35 deg API.

By John F Hyam,
Sarnia, Ont., Canada



Hold CLOSE WATER LEVEL on fast-steaming boilers taking rapid swings

Here is one of two COPES Flowmatics serving 810-psi, 825-F C-E Type VU boilers in one of New York State's most modern paper mills. Rated at 110,000 pounds per hour, each boiler is subject to a sharp load change every three minutes. Despite this severe service, drum water level is held within plus-or-minus one inch.

NORTHERN EQUIPMENT COMPANY

101 Grove Drive, Erie, Pennsylvania

BRANCH PLANTS in Canada, England, France, Austria, Italy • *Representatives Everywhere*

The story of this important installation is told in Performance Report Bulletin 479. Write on your letterhead, please for your copy.

COPES

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PLANT EQUIPMENT NEWS

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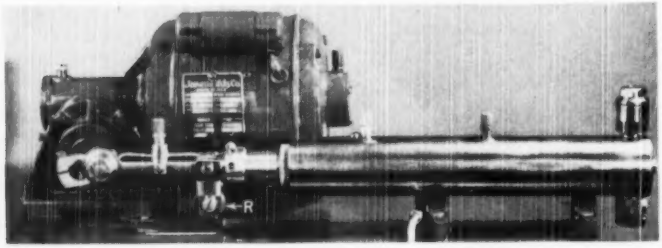
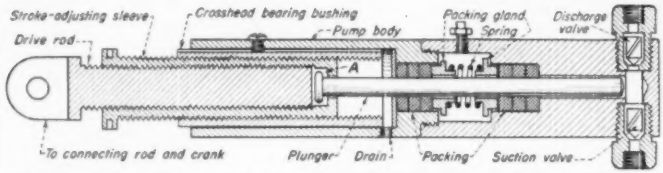




Chemical proportioning pump has a stroke with infinite adjustments from 0 to 2 in. Drawing shows screw-operated stroke sleeve for plunger changes so . . .

PUMP HAS INFINITE STROKE ADJUSTMENTS

P101 • Motor-driven, variable-stroke, positive-displacement, Nelson chemical proportioning pump has free-floating plunger. Plunger diameters range from ¼ to 1 in., with stroke adjustable from 0 to 2 in. Pump operates at speeds up to 60 rpm and pressures to 4000 psi.

Pump has a cylindrical crosshead connected by a constant-throw crank to the power unit. Stroke adjustment is made by a sleeve threaded into the crosshead and onto drive rod, as in drawing above. Screwing sleeve into or out of crosshead shortens or lengthens the plunger's stroke by increasing or decreasing the lost motion at *A* between the drive rod and sleeve head.

Thrust from the connecting rod to the crosshead is taken by a ball-bearing roller *R*, riding on a track in the photo shown at top of the page. Crank turns clockwise so that connecting-rod power thrust is downward on this bearing during each discharge stroke. This leaves the crosshead free, eliminating crosshead wear, and stroke adjustment may be made while pump operates.

A pump without motor drive may be installed as a linkage-drive unit. Such an installation may be made by directly connecting the pump's drive rod to the crosshead arms of a reciprocating pump or to any machine having a reciprocating or oscillating movement.

Nelson Pumps, Wright Chemical Corp, 627 West Lake St, Chicago 6, Ill.

QUICK FREEZER **P126**

Continuous packaged quick freezer, *Freez-Pak*, is capable of handling 4000 pound-packages of frozen food per hour or hardening 8000 pint packages of ice cream in a continuous cycle.

Food freezer consists of a structural-steel framework with 80 aluminum freezer trays containing 12 shelves 5 ft wide. The ice-cream quick hardener has 50 trays with 7 shelves 5 ft wide. The freezer tray never leaves the cold room. Only food or ice-cream packages enter and leave so there is no chance for frost or ice to build up on freezer trays.

Space required for a *Freez-Pak* of 4000 lb per hr capacity is 22 ft long by 19 ft, 11 in. wide by 8 ft, 9 in. high for loading and discharge section.

Freezing Equipment Sales, Inc, 415 W Market St, York, Pa.

HOSE AND FLANGE **P102**

Tough, flexible *Penflex Titepak* metal hose and flange withstands pressures up to 350 psi. It handles highly volatile liquids and stays leakproof.

Pennsylvania Flexible Metallic Tubing Co, 1528 Walnut St, Philadelphia 2, Pa.

SAFETY SWITCH **P169**

Small over-all dimensions are accomplished by compact design of the *Lo Ohm* switching mechanism. Switch handle is on front for easy, full-view operation. Modern automobile-type cast-aluminum handles make switch suitable for close ganging.

Silver plating is standard for all current-carrying parts. Enclosure is of code gage steel. Provision is made for padlocking handle in "off" position.

Dept CG, Metropolitan Electric Mfg Co, 22-50 Steinway St, Long Island City 5, N.Y.

PROPORTIONING PUMPS **P149**

Chemical proportioning pumps have ceramic wet-end parts, with reagent head, valves and valve housing armour-encased in porcelain. Valve seats gaskets and diaphragms are of inert fluorinated hydrocarbon plastic.

Pumps can handle all acids other than hydrofluoric, all metal salts except strong caustics, chlorinated hydrocarbons, halogens and liquids that must be kept free of metal ion contamination. No stuffing box or running seal required. Flow rate adjustable while pump operates. Both manual and automatic control are available. Capacities range up to 5.5 gpm and pressures up to 100 psi for large units and 250 psi for small sizes.

Lapp Insulator Co, Process Equipment Division, LeRoy, N. Y.

AIR HOSE **P123**

Three-ply fabric reinforced red-covered air hose has tube and rubber made of oil-proof rubber compounds.

Tube of the new hose will not flake off. Hose comes in ¼, 5/16 and ⅜ in. sizes with outside diameters of ½, 9/16 and 21/32 in. It weighs 10.3, 12.2 and 15.1 lb per 100 ft, respectively.

B F Goodrich Co, Akron, Ohio.

RUST-RESISTANT PRIMER **P130**

Multi-purpose, moisture-proof metal primer, *Led-Chlorixide*, is a balanced blend of red lead, zinc chromate and iron oxide. It provides a tough, highly impermeable, rust-resistant film foundation for finish coats.

Thompson-Porcelite Paint Co, 330 Race St, Philadelphia 6, Pa.

(*Continued on page 140*)

For further data on above items use reply cards on page 184a, identifying your request with letter *P* and number

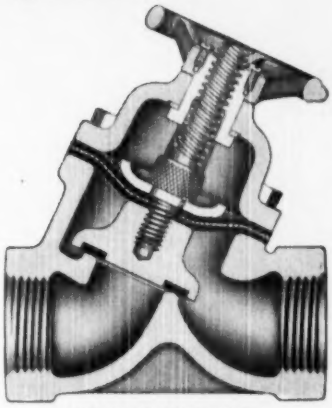
Piping equipment for every system... from one complete line

FOR BETTER CONTROL OF HARD-TO-HOLD FLUIDS

Crane Diaphragm Valves—in plain iron or Neoprene-lined types—are ideal for conveying compressed air, compressed or liquefied gases, volatile and corrosive fluids. Crane separate disc-diaphragm construction—a revolutionary improvement in packless valve design—makes these new valves safer, more durable, more efficient.

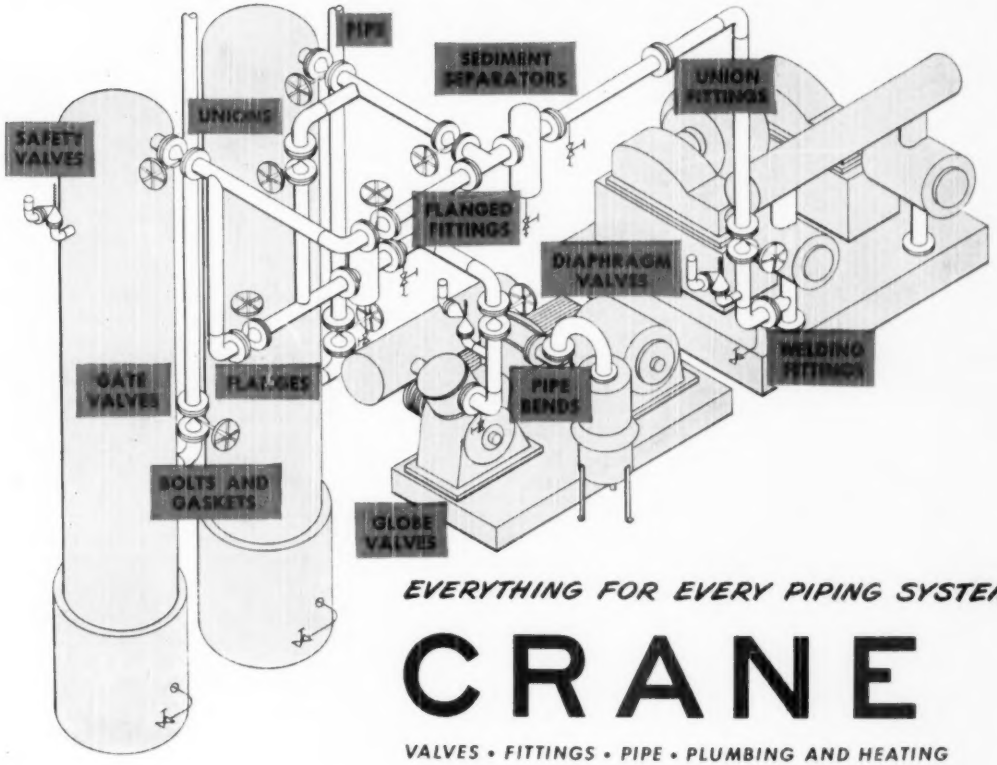
On Crane valves, the diaphragm is used only to seal the bonnet . . . is not subject to cutting, crushing and rapid wear. A separate circular disc permits positive shut-off even should the diaphragm fail. Y-pattern body design assures greater flow capacity, minimizes pressure drop. Crane separate disc-diaphragm design reduces appreciably the torque required to operate these valves. For further information, WRITE FOR CIRCULAR AD-1761.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



WORKING PRESSURES:
Up to 150 pounds water, oil, air or gas—180° F. max. temp. Sizes up to 6 in. Screwed or flanged ends.

ONE ORDER TO CRANE COVERS ALL PIPING NEEDS . . . FOR THIS AIR COMPRESSOR INSTALLATION, FOR EXAMPLE



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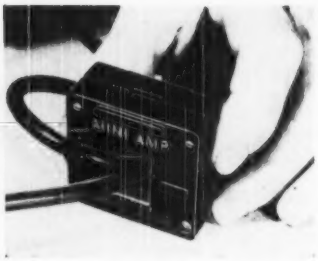


CURRENT INDICATOR **P170**

Mini-amp indicates load current of motors and other ac-operated electrical devices. Device is less than 2x2x1 in. thick with an opening in the center to take the carrying current line.

A neon indicator lamp glows at minimum amperage flow depending on number of turns through center. Available in different ampere ratings, these devices can serve to check motors and other circuits for overloads.

Industrial Devices, Inc., Edgewater, N.J.

OIL BURNER PUMP **P144**

Positive-displacement variable-volume pump is submerged in the oil reservoir of industrial oil burners to meter fuel.

The pump makes it possible to burn without manual adjustment any weight of industrial oil from No. 1 to No. 6 or Canadian bunker Q oil. Rate of oil feed is governed by the length of piston stroke, controlled by a cam mechanism.

Control lever is operated either manually or automatically. When lever is in high-fire position, cam permits spring-operated pistons to draw back to full stroke, filling the cylinders with oil for large-volume feed. When the lever is in low-fire position the cam cuts down the piston stroke to where the cylinder fills for small-volume feed.

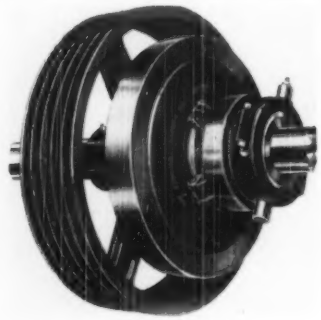
Iron Fireman Mfg Co, 1305 S W 12th Ave, Portland 1, Ore.

CUTTING TOOL **P141**

Spearhead Cutter combines the functions of a circle cutter, straightedge, compass, scorer and knife in a single manually operated device.

Made of durable phenolic plastic the cutter weighs less than four ounces and is 4¼ in. long, 1¼ in. wide and ¾ in. high. It cuts accurate-size gaskets from any pliable sheet material in round, odd, straight, square, rectangular, oval or other irregular shapes. Manufacturer says device will accurately cut a ¼-in. hole in material ⅛ in. thick.

Zimmerman Packing Co, Cincinnati, Ohio



CLUTCH **P151**

Type SF clutch mechanism for starting and stopping the flow of mechanical power. New design incorporates an extended bronze bushed sleeve, tapered on the outside diameter to fit tapered bore of sheave.

To assemble sheave on sleeve, remove grease fitting, place sheave over taper, and use the standard pull-up bolts to draw sheave snugly into place. This new design eliminates the operations often necessary with straight sleeve in re-boring the sheave, drilling and tapping into web of extended sleeve bowl, and cutting keyways.

The Edgemont Machine Co, Dayton, Ohio

(*Continued on page 142*)

Did You See?

Dust Classifier that grades dust particles from typical flue-dust samples and gives data for a graph analysis within 2 hrs ..... page 182

Gas Burner that handles any combustible mixture of gas over a wide range of pressures from 0.1 in. water to 1½ psi ..... page 170

Process-Heat that can be furnished from a self-contained, direct-fired heating unit burning either gas or oil ..... page 184

Controlled Humidity that you can get from a compact, totally enclosed, unit-air-conditioning system for volumes from 1000 to 20,000 cfm of air at room temperatures ..... page 166

Standardized Boilers that bring to 2-drum watertube boilers in the 10,000 to 45,000 lb-per-hr class the advantages of compact, symmetrical bent-tube design ..... page 178

Water Treatment preparations that meet specific requirements for small and medium-sized steam plants page 168

Intake Screen that removes trash and large solids from water intakes with a power-operated cleaning mechanism ..... page 176

Oil-Burner Pump that has positive displacement, and variable volume to meter fuel to rotary-cup atomizing oil burners ..... page 140

Centrifugal Pump that is made of stainless steel to be used in handling acid and alkaline solutions ..... page 174

Motor and Starter that is a manual, auto-transformer type for squirrel cage motors. Equipment has a switch mechanism with a quick-make, quick-break action ..... page 140

Capacitor Motor specially-built to minimize over-all dimensions of ½ to 5 hp high torque, integral-horsepower model ..... page 144

Cable-Splice Housing that has a plastic housing to eliminate lengthy outside-wrapping operations for joining electrical cable. Main structural part of housing is a pipe made from a tough, corrosion-proof blend of synthetic rubber and thermoplastic resins page 172

And Next Month...

Cold-Weld Process that gives good intermolecular bonding between metals by squeezing metal pieces together.

What a Cold, Calculating Beating this Lug takes!

IT'S NEW! IT'S DIFFERENT! IT'S MADE OF REVERE COPPER —The "Double G" Solderless Lug made by THE GREGORY MANUFACTURING CO., INC., New Haven, Conn., for the electrical field, comes in 6 sizes to accommodate from 14 ga wire to 1,000,000 CM cables. Pressure screws are steel.

HOLD 'EM TIGHT—These sharp, deep-cut serrations on inside of both tubular sections and projection tang help to make firm, non-slip joints possible. They also increase the rigidity and conductivity of the connection. Note that these serrations were made cold, and without any distortion of the Revere Copper used. Lugs shown are twice actual size and are unretouched.

...and not a Scar to show for it!

Improved solderless lug of hard drawn Revere Copper, cold worked over and over without distortion, cracking, pitting or scarring.

Pierced, formed at short 45 degree and 90 degree angles and deeply serrated, this "Double G" solderless lug really gets a working over . . . and cold, too, no annealing. Yet, with all this, the surface remains absolutely smooth, the lug is not in any way weakened and there is no twisting, pitting, cracking or scarring of any kind. And, in addition, its dimensions are held.

When the Gregory Manufacturing Co., Inc., was developing this solderless lug, with its unusual features, it had a problem on its hands.

Their design called for copper strip that could stand a lot of cold working and when finally fabricated into a product of uniform quality, would not have a lot of twist, cracks, pitted or scarred surface. In their efforts to secure such a product their engineers had frequent consultations with Revere's Technical Advisory Service. The result was the product shown and described above, with production time and money saved and rejects held to the vanishing point. The material used was Revere hard drawn copper strip with a temper of 36 to 46 Rockwell B Scale. This company feels that they could not have developed such a successful product if the quality of the copper was not of the best and did not possess the inherent working characteristics needed.

Perhaps Revere Copper or some other Revere Metal can be of help in developing or improving your product—cutting your production costs. Why not tell Revere's Technical Advisory Service about your metal problems? Call the Revere Sales Office nearest you today.

REVERE

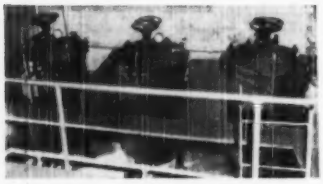
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

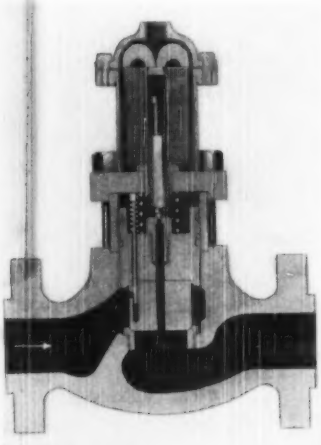


OIL-REMOVAL PROCESS P171

Cylinder oil is removed from condensate by constant admixture of an oil-absorbent slurry and filtering-through paper. A proportioning pump feeds the slurry at the needed rate. Operation of the process is almost automatic, taking not more than an hour or two of a man's time every 36 hr. In addition to high efficiency of oil removal, maker claims that solid products of filtration are easily disposable and do not constitute a stream-pollution factor.

An 8-month test on a 2000-hp installation showed that cylinder oil in condensate was reduced from 20 ppm to less than one ppm with a flow rate of 2.5 to 3.5 gpm per sq ft of filter area at a temperature of 125 to 160 F. Oil removal is constant from beginning to end of cycle.

Sparkler Manufacturing Co, Mundelein, Ill.



SOLENOID VALVE P136

Electro-Hydraulic solenoid valve is suitable for oil or oil-vapor service on temperatures up to 1000 F and for steam, water, air, gas and general service on temperatures up to 850 F.

Valve is packless and operates from a 6-v storage battery. Forged steel valves come in sizes from ½ to 2 in. screwed or flanged.

Corrosion-resistant valves from ¼ to 3 in. inclusive are available in 18-8S, 18-8SMo, acid bronzes, aluminum, *Ampco Alloy*, D-10, *Everdur*, *Hastelloy* and other alloys.

Hoppe Engineering Co, Greensboro, Ind.

COMBUSTION SAFEGUARD P112

Industrial and commercial fuel-fired boilers can make use of electronically operated flame safeguard, *Flame-otrol, 1300*.

This control uses the flame itself as a working part of the protection circuit to give instant switching action on flame failure. The 1300 series has a guaranteed safe-start. In addition it has interchangeable plug-in units for increased program variety, easily adjustable to a wide selection of purge, preventilating and ignition program cycles.

Wheelco Instrument Co, 847 W Harrison St, Chicago 7, Ill.

⑦

#	1	2	3	4	5	6	7	8	9
97	09	19	29	38	48	58	67	77	87
(87)	08	17	(26)	34	43	52	60	69	(78)
77	07	15	23	30	38	46	53	61	69
67	06	13	20	26	33	40	46	53	60
57	05	11	17	22	28	34	39	45	51
47	04	09	14	18	23	28	32	37	42
37	03	07	11	14	18	22	25	29	33
27	02	05	08	10	13	16	18	21	24
17	01	03	05	06	08	10	11	13	15
07	00	01	02	02	03	04	04	05	06
–5	7	4	①	8	5	2	9	6	③

MULTIPLICATION CHART P131

Clearly printed chart, cased in moisture-proof nonglare plastic, cuts multiplication time more than 50% and yields exact numerical answers.

Block 7, here reproduced from chart, shows how to multiply two 2-digit numbers, the first of which ends in 7. Circled numbers show reading to multiply 87x93. Write down 783 and below it, shifted one place to the right, 261. Add to get the product 8091 as below.

This chart, less than a foot square, is the invention of John L. Garwood, a former government disbursing officer. The time saving is said to be even greater in multiplying numbers of three or more digits.

Disbursing Agents Computing Co, Inc, Suite 901, 25 Broadway, New York, N. Y.

PLASTIC NAMEPLATES P147

For identification of valves, switches, instrument panels, and gages, laminated plastic nameplates are made in 1/16, ⅛ or ¼ in. thickness with the characters engraved in them. Surface layer of these plates is black, white or red, and the core is a contrasting color.

Letters, diagrams, trademarks are clear cut, highly legible, and permanent. The plastic is impervious to changes in temperature, weatherproof, fumeproof. It can be wiped clean with a damp cloth.

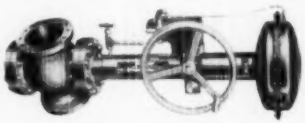
Industrial Nameplate Service, PO Box 5005, Houston 12, Texas

MOTOR SPEED-CONTROL P157

Type 1701-A *Variac* speed control will handle a 1/20-hp dc shunt motor or a 1/15 hp universal motor from an ac line. Range of continuous speed variation available is from motor-rated speed down to nearly zero at constant torque. A working range of 30:1 can be obtained with shunt motors, and of at least 50:1 with most universal motors.

Motor can be reversed almost instantly by merely flipping the forward-reverse switch. No time delay is necessary in starting or in reversing. Controls are housed in a metal cabinet about 6¾ x 5⅜ x 4¾ in.

General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.



HANDWHEEL VALVE P145

Continuously connected handwheel positions diaphragm-controlled valve under any condition regardless of instrument air pressure on the diaphragm or in opposition to the spring. Stops can be set to limit valve stroke to 0 to 100% of travel.

Position indicator shows the valve plug position and setting of the travel stop. It also shows the percent of free travel of

For further data on above items use reply cards on page 184a, identifying your request with letter P and number

DUQUESNE LIGHT COMPANY'S Frank R. Phillips Power Station at Wireton, Pa. Units 2 and 3, now being constructed by Dravo, will more than triple the original 75,000 kw capacity of this key station serving the Pittsburgh area.

DRAVO
CORPORATION

DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering Constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations—fabricators and erectors of power piping—power and boiler plant equipment.

PITTSBURGH · PHILADELPHIA · CLEVELAND · NEW YORK · DETROIT

EQUIPMENT NEWS *CONTINUED*

the valve plug and in what portion of the valve stroke free travel occurs.

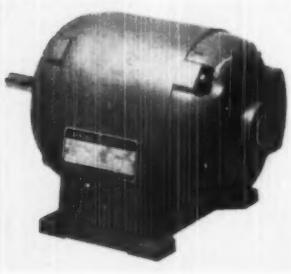
Worm gear permits mounting the handwheel unit integral with the spring barrel. This gives a straight-line lift on the valve stem for any travel up to 4 in. Power applied to valve stem is the same at any point in the valve stroke. Valve wheel operates with valve in either vertical or horizontal position. A chain wheel can be used for remote control. Handwheel may be applied to valves of 1¼ in. to 16 in. size.

Hammel-Dahl Co, 243 Richmond St, Providence 3, R. I.

AIR HOSE P138

Designed specifically for paint-spraying equipment the hose is light and flexible. The one-braided type comes in three sizes, ¼, 5/16 and ⅜ in. Two-braided style is 7/16-in. size.

The B F Goodrich Co, Akron, Ohio



CAPACITOR MOTOR P162

To minimize over-all dimensions of this integral-horsepower *Tri-Clad* motor, capacitors are mounted in the base and there is no conduit in box on the side. Conduit box has been replaced by a built-in terminal board inside the end shield for easier wiring.

In ratings from ½ to 5 hp, these high-torque motors are available in two types: Types KCS, capacitor-start, and Type KCR, capacitor-run. The KCS motor is designed for 115/230 volts, while the KCR motor is a single-voltage 230-v design. Motor is equipped with long-life lubricated ball bearings that run for years without relubrication. But readily accessible grease fittings make possible easy lubrication when it becomes necessary.

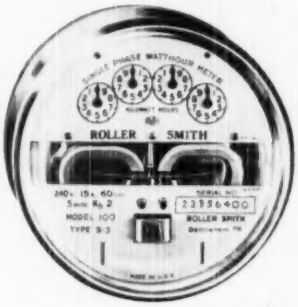
General Electric Co, Schenectady 5, N.Y.

DRAFTING BOARD P103

Light, strong drawing board results from air-cell or honeycomb design employing outer strips of plywood panels with honeycomb between.

Entire board has been dipped in a waterproofing agent to seal in honeycomb construction. A straight-edge gear-rack aligner makes T-squares unnecessary. Board comes in sizes from 12 by 17 to 31 by 42 in.

Cal-Pan Corp, 1111 S Fremont Ave, Alhambra, Calif.



WATTHOUR METER P152

Socket-type meter uses unit construction of all four major assemblies: base, electromagnet, damping system and register. This construction permits meter to keep in step with load growth since current and potential coils can be quickly replaced with coils of other ratings.

Type S-3 meter is available in 2- or 3-wire single phase, 5- or 15-amp rating for 120- or 240-volt service. It may be had with either clock-type or cyclometer registers.

Roller-Smith, Dept EM, Bethlehem, Pa.

CORROSION INHIBITOR P139

Brooks D-O Corrosion Inhibitor is easily soluble in water and readily combines with any dissolved oxygen present.

One or two pounds effectively treat 5000 gallons of feedwater.

The Brooks Boiler Treatment Co, 3304 E 87th St, Cleveland 4, Ohio

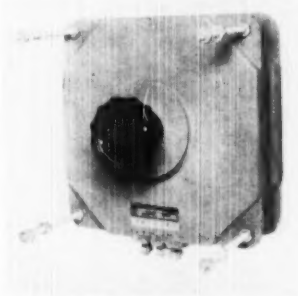


PLATE-TYPE RHEOSTAT P154

Rheostat is designed for field control of dc shunt- or compound-wound motors, self-excited generators, exciters, separately excited generators and synchronous motors. It is suitable for paper, textile, machine-tool industries, as well as rotating-equipment builders.

Rheostat features adjustable stops that limit dial-switch movement at each end of travel. These stops are adjustable through a 90-degree angle, making it possible to adjust maximum and minimum resistance that can be cut in or out of the circuit.

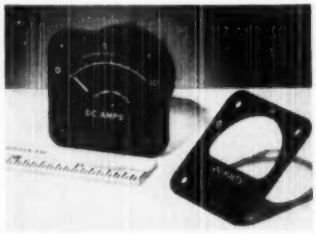
General Electric Co, Schenectady 5, N. Y.

OVERCURRENT RELAY P161

An overcurrent relay provides adequate fault protection for distribution feeders. Usually when a feeder is re-energized after an extended outage the accumulation of loads causes an inrush current to flow. Type *IAC-77* relay takes care of this by having an extremely inverse time characteristic curve with a shape approximating those of power fuses and distribution cutouts.

New relay has the usual features of other overcurrent relays such as time dial, tapped coil, single contact with target-seal-in device and provision for instantaneous attachment.

General Electric Co, Schenectady, N.Y.



PANEL METER P163

This one basic meter can be used for several ranges by adding external accessories, and by merely changing the face plate. The dc self-contained instrument ranges from 50 to 500 microamperes; from 1 to 500 milliamperes, and from 1 to 15 amp.

External shunts with leads permit higher ranges. As an ac meter of the rectifier type, the range is 1 to 500 v, completely self-contained. External resistors can be added to provide higher ranges. Meter accuracy is ∠ 2% of full scale for dc operation: ∠ 5% when used as an ac instrument.

International Instrument, Inc, 331 East St, New Haven 11, Conn.

DUST COLLECTOR P129

Highly efficient, cyclone type of dust separation results from the new *Valmont Type S*, which has a relatively small diameter and longer tube length.

Gas is introduced in a deep, narrow ribbon through a single-inlet slot so dust particles can travel only a very small horizontal distance before meeting the precipi-

(*Continued on page 164*)

For further data on above items use reply cards on page 184a, identifying your request with letter P and number

It was 1912—and Arizona was admitted to Statehood as the 48th State—when we introduced "Flexitallic," the *original* Spiral-Wound Gasket, and opened to Industry new fields of opportunity in the confining of fluids at high pressures and high temperatures.

WHEN A HIGH-PRESSURE GASKET FAILS...

What does it cost you when a high-pressure gasket fails? . . . In danger to personnel . . . damage to equipment . . . loss of operating time? Calculate the cost—*total*—and then decide whether you can afford to use anything less than the safest high-pressure seal.

It was just such calculations that convinced oil refineries, chemical industries, power plants, shipyards and steamship operating companies, and others who are *seriously* concerned with high pressures and high temperatures to standardize on Flexitallic, the original Spiral-Wound Gaskets.

They *know from experience.*

When you specify Flexitallic Gaskets, you set in motion scientifically devised controls for the determination of yield values, resilience and gasket density. You can see the results of Flexitallic precision — greater safety, gasket efficiency and economy of operations.

If you are *seriously* concerned with confining fluids safely and *do not know from experience* of the superior performance of Flexitallic Spiral-Wound Gaskets, write us on your company letterhead, giving us the following facts regarding your sealing requirements:

- (1) Fluid to be confined
- (2) Type of flange and dimensions
- (3) Operating pressures and temperatures
- (4) Bolting data

Within a few days you will receive a *genuine* Flexitallic Spiral-Wound Gasket with our compliments. Subject it to the most severe tests—in the laboratory or on the job . . . let your own *experience* tell you why nearly every industry *seriously* concerned with safe seals of high pressures and high temperatures is standardized on *genuine Flexitallic* Gaskets.

FLEXITALLIC GASKET COMPANY
Eighth and Bailey Streets, Camden 2, New Jersey

The name "Flexitallic" is the registered trade mark identifying the *original* (patented) Spiral-Wound Gasket. Now—for your protection and ours—this trade mark FLEXITALLIC is stamped into the outer ply of every *genuine* Flexitallic Gasket. Your guarantee of quality.

A Look Into the Future

If any of your friends or associates have been crying the blues lately about the future of this country, or telling you how bad things are going to be 20 or 30 years from now, make them read an article titled, "How Big in 1980?", in the November issue of *The Atlantic Magazine*. Here are some of the forecasts:

Output of the American economy will be at least 416 billion dollars per year (in terms of present prices) as compared with 246.7 billion dollars in 1948.

The per-worker output (based on today's prices) will be $5744 in 1980, as compared with $4065 in the year 1948.

The population of the U.S. will be at least 175 million by 1980, an increase of about 30 million in 30 years.

The work week in 1980 will be approximately 30 hours, down 10 hours from the current level of around 40 hours per week.

In addition to these specific predictions, the author says, "People will have far more leisure and they will consume at least 50% more per capita than now, and probably from 75 to 100% more. The U.S. will gradually become a country of two-family cars and in another generation 70 million or more cars will be on the road. This will make much of the present road system obsolete. Air conditioning in restaurants and office buildings will create a demand for much air conditioning in homes."

Maybe this crystal-ball gazer is only 25% right, as sometimes happens to people who insist on looking into the future. So let's grant him at least a batting average of .250, which means plenty of growth for America. Translate this into terms of our own interest—POWER—and you come up with a picture something like this:

Expansion of power facilities of all kinds will continue because better roads, more air conditioning, greater output per worker cannot be achieved without more power.

The industry that has enjoyed the greatest growth since the end of the war is the electric utility. As manufacturing continues to increase its demand on power to help turn out more goods per worker, the importance of the power department will grow. This adds up to a *greater demand for men who can plan, operate and maintain power plants and equipment.*

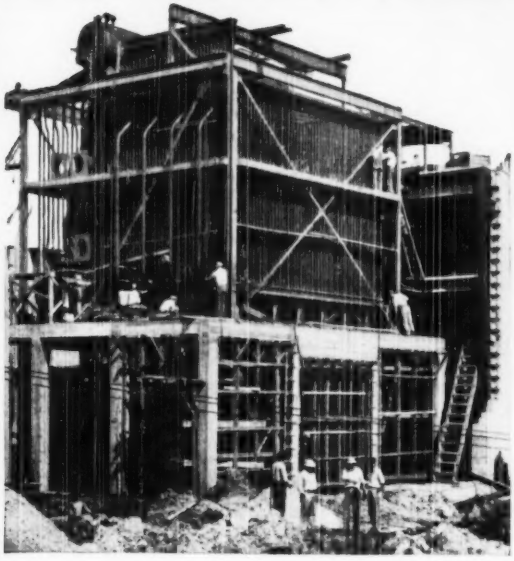
I'll go out on the limb and make this prediction: The power engineer of 1980 will be a more important man in the professional community because he will be called on to make a greater contribution to our economy. This is an opportunity to be accepted and prepared for.

George Edwards

Engineer

DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS



Clean That New Boiler!

REMOVE MILL SCALE AFTER ERECTION— The Chemical Way!

WHEN you install a new boiler, you'll find it to your advantage to specify removal of the mill scale *after erection*, using Dowell Chemical Scale Removal Service. The Dowell method eliminates much of the extra care required in the handling of previously sand-blasted or pickled tubes—*and* many power engineers have found that the *chemical* removal of mill scale from new boilers before the first firing results in more satisfactory boiler operation.

Unless removed, mill scale may retard heat transfer, slough off particles which abrade the system during operation, and act as a base for further corrosion.

Dowell engineers are selected for ability, trained in field and laboratory, and backed by the experience of thousands of successful jobs. They use mobile pumping equipment to fill the new boiler with specially selected liquid solvents which can reach wherever steam and water flow. They bring with them all necessary mixers, heaters and control equipment to perform the cleaning operation.

Put Dowell Chemical *Mill Scale Removal* Service in your new boiler specifications! Call on Dowell also for estimates of the cost of cleaning your present boilers, condensers, heat exchange equipment, water lines and water wells.

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

CALL

New York 20, Boston 16, Philadelphia 2, Baltimore 18, Wilmington 99, Richmond 19, Jacksonville, Atlanta, Buffalo 2, Cleveland 13, Pittsburgh 19, Detroit 2, Chicago 2, St. Louis 8, Indianapolis, Louisville, Kansas City 8, Wichita 2, Oklahoma City 2, Houston 2, New Orleans 12, Ft. Worth 2, Shreveport 69, Anniston, Ala., Mt. Pleasant, Mich., Hamilton, Ohio, Charleston 27, W. Va., Salem, Illinois, Borger, Texas, Midland, Texas, Wichita Falls, Texas, Lafayette, La.

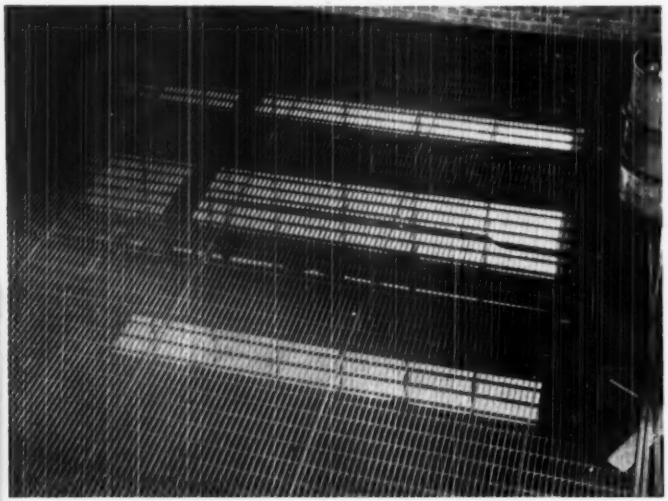
Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

Where you need light and air

use Hendrick Open Steel Flooring with its 90% open area



PLENTY OF LIGHT AND AIR THROUGH THREE FLOORS

With its minimum obstruction to the passage of light and air, Hendrick Mitco Open Steel Flooring will support heavy loading without any lateral deflection of the steel bars.

Made into integral panels, under hundreds of tons of hydraulic pressure, there are no bolts, rivets or angle irons to loosen, or to collect dirt or refuse—no welds, liable to have residual stresses and lead to warping.

* * *

Unequalled for floors, loading platforms, ramps and driveways that have to withstand heavy traffic, Hendrick Mitco Armorgrids do not depend on the fill for development of full strength to resist shock loads.

The rectangular, square-edge bars provide a thoroughly safe, non-slipping, level walking surface.

For stairs, ladders and fire escapes, Hendrick Shur-Site Treads offer all the advantages of Mitco construction. A valuable safety feature is a heavy, flanged nosing-bar that gives sharp visibility to the edge of each tread and also provides additional strength where the load is greatest.

Write for Catalogue of Hendrick Mitco Products

SEE OUR CATALOG IN SWEET'S

HENDRICK

Manufacturing Company

46 DUNDAFF STREET, CARBONDALE, PENNA.

Sales Offices In Principal Cities

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring, "Shur-Site" Treads and Armorgrids

ELECTRONICS

(*Continued from page* 118)

ergized to repeat the cycle just described. Thus by recharging the diaphragm after each cycle, the system can be made to oscillate continuously. This is the same as is done in the electric system by closing the switch to the battery, for an instant at the right time.

Feedback Circuit: All sustained oscillating systems have some means in them to feed back, to the grid, part of the power passing through a vacuum tube or tubes. Fig. 10 shows the simplest form of an oscillator. It includes an amplifying vacuum tube, a capacitor *C*, a high-frequency or tank coil *L* and a feedback coil *F*. The tank and feedback coils are coupled inductively. That is, any change in the magnetic field in *L* induces a voltage in *F*.

Assume the system is connected to a dc supply. Almost instantly capacitor *C* is charged to the polarity indicated, current flow being from — line through the tube into the capacitor. In this operation until the capacitor is charged it acts almost as a short circuit across coil *L*. Current flow to the capacitor then is limited only by voltage drop across the tube. As current flow decreases voltage drop across the tube decreases until the capacitor is charged almost to line volt.

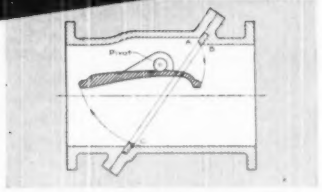
The capacitor then discharges through reactor *L*. Energy stored in the capacitor is transferred to the magnetic field of the reactor. Current flow through *L* is as arrowheads indicate, Fig. 11. While the current is increasing a voltage is produced in *L* that opposes this increase. Consequently, feedback coil *F* has a voltage induced in it, as shown, opposite to current in *L*. Voltage in *F* is in a direction to give the grid a plus bias. As a result, power is supplied through the tube to the oscillating system.

Minus Bias on Grid. When the capacitor has discharged, current through the reactor coil starts to decrease. In doing so the decaying magnetic field induces a voltage in the reactor that opposes the current change. Voltage is now reversed in *F*, Fig. 12, to give the grid an increasing minus bias. This bias decreases the current flow through the tube and blocks it as the capacitor becomes charged. Energy stored in the magnetic field of the reactor is now transferred to the capacitor, charged to the polarity shown.

Capacitor *C* now discharges up through the reactor, as in Fig. 13. In doing so, the increasing magnetic field induces a voltage that opposes increasing current flow in *L*. This voltage is downward as indicated on coil *F* so the grid still has a minus bias. When the capacitor is discharged its energy is

SAVE UP TO 80% IN HEAD LOSSES

with CHAPMAN TILTING-DISC CHECK VALVES



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

That's right! With Chapman Tilting-Disc Valves, head losses are 65% to 80% lower than for conventional type check valves.

But no wonder head losses are lower. Chapman Check Valves work with . . . not against . . . the stream. The balanced disc rides smoothly on the flow . . . lifts away easily in opening and closes quickly and quietly. There's no slamming to cause destructive pipe line stresses . . . minimum wear on seats, hinge pins and bearings.

All these features mean lower maintenance costs for you. So write *today* for additional information.

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

The maintenance of expansion joints in difficult-to-service or remote locations is costly in both man-hours and shutdown losses. ADSCO *Corruflex* Packless Expansion Joints *eliminate* those costs by eliminating the causes. They never require packing or maintenance of any kind.

Corruflex Joints are on the job all the time . . . absorbing pipeline expansion and contraction resulting from temperature changes . . . protecting lines and equipment from undue strain.

And ADSCO *Corruflex* Joints are easy to install. Their compactness—with a maximum outside diameter scarcely larger than that of an ordinary flange—makes them ideal for use in trenches, tunnels or other cramped quarters where maintenance costs may be unusually high.

Like other ADSCO products, *Corruflex* Joints are built to the highest standards. They are available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings, and with flanged or welding ends. They are supplied in copper, stainless steel or other alloys and with internal sleeves if required.

Corruflex Joints have traverses ranging from fractions of an inch to 15" and will operate under pressures from vacuum to 300 psi and temperatures from sub-zero to 1600 F.

For dimensions and further information, consult your ADSCO representative or send us your requirements for our recommendation. For descriptive literature, write for Folder No. Z-149.

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STEAM TRAPS — STRAINERS — METERS
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NORTH TONAWANDA, N. Y.

stored in the reactor's magnetic field.

When the current starts to decrease through the reactor, the decaying magnetic field induces a voltage in *L* that tends to keep the current flowing. This reverses the induced voltage in *F* to give the grid a plus bias. The tube now passes current to compensate for the energy loss in the oscillating circuit. This gives capacitor *C* a full charge to start the next oscillating cycle, as diagrammed in Fig. 10 to 14.

Grid-Bias Impulse. Since the grid-bias impulse comes from the oscillating circuit the two must bear a definite relation to each other, no matter how high the oscillating frequency becomes. Each time there is a current increase or decrease in the reactor coil it causes a like change in the feedback circuit voltage to the grid to control the tube's operation.

We have just studied what is known as a self-excited oscillator in its simplest form. This type oscillator of proper design can operate at frequencies up to billions of cycles per second. The next article will consider some of these designs and induction and dielectric heating.

PICKLING STATION

(*Continued from page 78*)

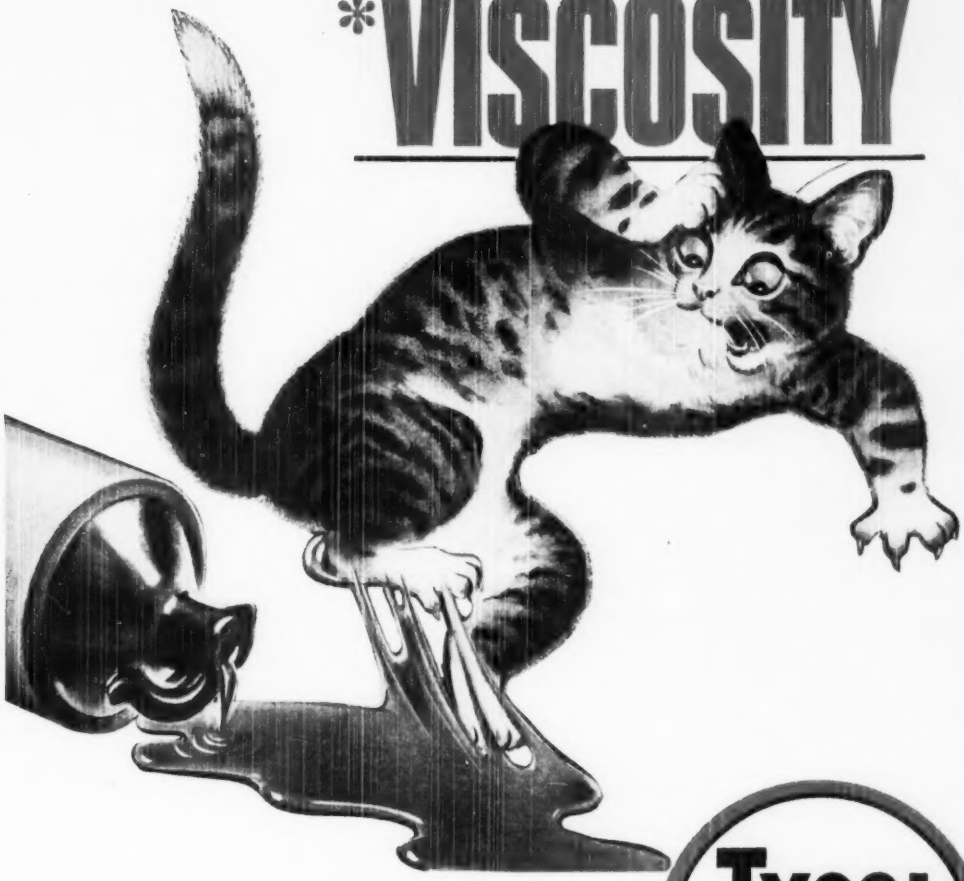
Automatic intermittent chlorination of the water leaving the screens prevents organic growths in the tunnels, pumps and condenser. Three vertical circulating pumps, two with 8760-gpm capacity and one with 4380, give flexibility in meeting cooling-water needs. Water pumps into the circulating-water header. From here it passes to the condensing, hydrogen-cooling, screen-washing, ash-sluicing and house-service systems. These systems being under a positive pressure need no priming facilities.

Y-type reversing valves allow the condenser to be backwashed without interfering with normal operation. Water flows out the discharge tunnel, over a weir directly above the intake structure, along the river bank, and then into the river about 300 ft below the intake tunnels.

Two mud valves in the floor of the pump bay, lowest plant elevation, are a precaution against high flood water. Sluice gates at the screen house can shut off the circulating water. Then, by opening the mud valves, the circulating-water pumps can be used to pump flood water from the building.

Makeup. Makeup water comes from one shallow and one deep well, both within the building foundation. The water contains scale-forming salts and is chemically treated by zeolite softeners on the sodium cycle, reducing the hardness to zero. Makeup then passes to the evaporator, which has an

*VISCOSITY



All equipment will last longer — give better service — if you use the proper lubricant. That's why you'll find it profitable to use Tycol high quality oils and greases.

There's a reason! No matter what your lubrication need — for roll neck bearings or mine cars, Diesels or high speed textile spindles, turbines, paper calenders or steam engines . . . where *VISCOSITY, penetration, extreme pressure is a factor — Tycol has a lubricant suited to your specific requirements.

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This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

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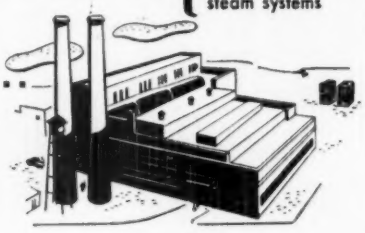
CORAVOL CASE HISTORY NO. 8

8th in a series describing CORAVOL results in steam systems

Type of Operation...

CENTRAL STATION POWER PLANT



OPERATING CONDITIONS: 4 condensing turbines with total capacity of 45,000 kilowatts. Turbine steam, 250 psi and 650°F.
Evaporation — 15,200,000 lbs. per day.
Make-up, distilled water, 0.5% of evaporation.

PROBLEM: Deterioration of metal in deaerating heater and boiler feed pumps. Heavy rust deposits in high pressure heater and surge tank.

CORAVOL STARTED: July 1943.

RESULTS: pH of condensate raised from 6.8 to a range of 7.4 to 7.8. No further damage to trays in the deaerating heater. No deposits of iron oxide in high pressure heater or in surge tank. Pumps operated continuously since 1943 with no loss of capacity or replacement of parts.

USER COMMENTS: This 45,000 KW plant operated for 33 consecutive months with an average capacity factor of 110% or an average load of more than 49,000 KW for 24,000 consecutive hours.

CORAVOL (the original* AMINE PROCESS)

PROTECTS THE INACCESSIBLE PARTS OF YOUR STEAM SYSTEM FROM CORROSION

CORAVOL in your steam system (1) prevents corrosion in lines, (2) cleans out clogging rust deposits. Thus, CORAVOL *protects lines;* improves heat transfer; restores original capacity of lines and efficiency of valves and traps.

CORAVOL is *not* a boiler feed water treatment—it is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates throughout your entire steam system and protects *all* zones from corrosive attack.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special formulas of chemical treatment for: boiler feed water . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

*The use of CORAVOL in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

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WESTERN CHEMICAL COMPANY

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integral preheater and deaerator. Evaporator distillate enters the feed-water cycle as vapor in the intermediate pressure heater.

The vertical deaerating heater mounts on a 12,000-gal storage tank. A second 12,000-gal feedwater storage tank in the basement provides additional storage for emergencies.

High- and low-pressure chemical feed pumps provide supplemental treatment. Chemical feeds continuously into the deaerator, and intermittently as needed to the boiler drum. Both boilers and evaporator blow down continuously. Boiler salines recirculate to maintain the feedwater pH between 8.6 and 8.8. Silica holds to not more than 5 ppm in the boiler salines. The station's modern chemical laboratory makes daily checks on water conditions throughout the cycle. Hypo-chlorinators purify all sanitary- and drinking-water supply.

Plant Layout. Boiler and turbine areas adjacent to each other on the operating floor level are separated only by a large control cubicle. The boiler-room face of the cubicle holds the combustion-control equipment and the gages, meters and switches for centralized control of firing operations. The cubicle's oppo-ite face, on the turbine-room side, holds the controls for the turbine-generator and hydrogen-cooling system.

On one side of the turbine room are the offices of superintendent, foreman and clerical force. Directly above, overlooking the turbine room, is the centralized control room. Main switchboard in this room controls output of the turbine-generator and all power circuits emanating from the plant. Circuit Breakers on all station service buses are also controlled from here.

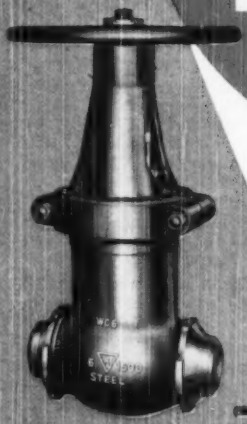
The meeting room, first-aid room, machine shop, storeroom and chemical laboratory are on the mezzanine or ground floor. Machine shop and storeroom are side by side in an extension of the plant. This wing also houses the chlorinator and screen houses. The coal-handling crew uses a separate shower and office in the track-hopper house.

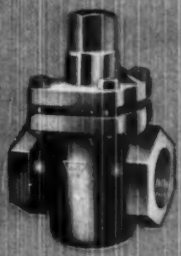
A complete alarm system indicates equipment failure or abnormal operating conditions. The 14-, 16- and 28-alarm points on boiler, turbine and pump panels, respectively, make it possible to operate the plant at night with five operators and a foreman, a total of six men.

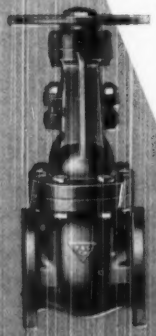
The voice-paging system consists of eleven 50-watt amplifiers, 25 microphones and 53 loud speakers throughout the station. Divided into two separate systems, it allows the coal-handling equipment to operate without confusion in the remainder of the station.

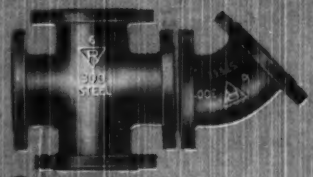
Simplicity, to the end of increased reliability, characterizes the electrical layout of the plant. The 13.8-kv 3-phase

more and better service from R·P&C VALVES









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"That the superintendent
"shall be held responsible
"for the production of goods
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"as shall make them merchantable
"and of a character that will serve
"to establish for this company
"a high reputation."

This policy has remained unshaken through two world wars. The "high reputation" has been maintained. More than ever before, the valves offered by R·P&C meet the demand for longer and better service.

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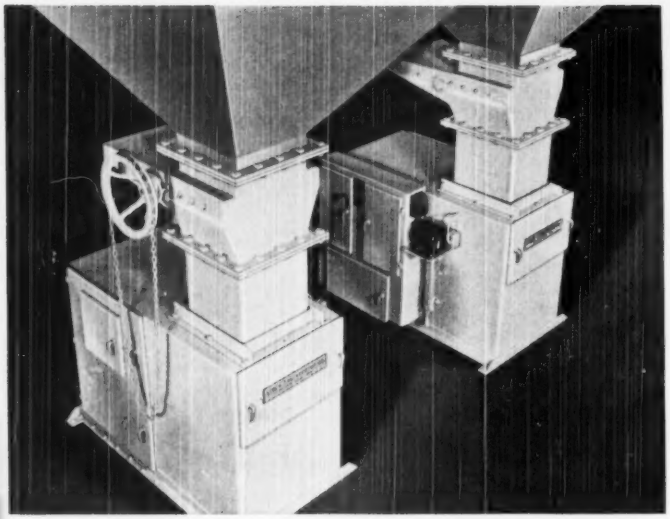

circuit from the main generator is carried as an isolated metal-enclosed bus (2000-amp rating) from generator to the main switchgear on the turbine operating floor. Switchgear consists of three air-blast air-operated breakers enclosed in a metal housing. In addition to the main-generator circuit breaker, the two other breakers control 13.8-kv circuits to the station-service 3000-kva 13800/440-v transformer, and to the 400,000-kva main transformer bank in the outdoor substation adjacent to the main building.

The 440-v switchgear supply station services motors of 25 hp and larger. The 120/208-v switchgear supply all small motors, control and lighting circuits. All this switchgear is on the mezzanine floor and all circuits are controlled by air circuit breakers.

There are two sources of electrical supply for all station-service buses. Main source is a 3000-kva 3-phase bank of transformers off the 13.8-kv generator bus. The other source is a 3000-kva 3-phase grounding bank from the 33-kv transmission system.

A direct-connected main and pilot exciter serves the main generator. A spare exciter is directly driven by a 250-hp 440-v motor.

Predicted over-all steam generator efficiency below, agrees very closely with actual operation:

Output, lb per hr	*Efficiency, %*
75,000	83.2
125,000	83.7
175,000	84.1

The station net heat rate varies as follows:

Load, kw	*Heat rate, Btu per kwhr* 95% *RE*	100% *RE*
7,922	15,747	14,960
15,532	13,526	12,850
22,919	12,942	12,295
30,249	12,716	12,080
33,216	12,721	12,085
36,094	12,895	12,250

The consulting engineers, Gilbert Associates, Reading, Pa., were responsible for the station design.

Technical Briefs

(*Continued from page* 130)

pressures, the densities of the fluids under test conditions were ascertained. This investigation was run to determine density-pressure relationships of the two dimethyl siloxanes. Although the results of this investigation on only two of the silicone liquids can't be conclusive enough to yield a density-pressure equation for all silicones it may lead to further data that could give such an equation for silicones like that of Dow and Fink for mineral oils.

The author describes the testing apparatus used and the checks through

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Sampling door, provided in the side of the S-E-Co. Scale, enables operators to take a sample of coal just before the coal falls into the weigh hopper. At this point it is possible to obtain a complete cross section of the coal stream. This representative sample is the first step in accurate coal analysis.

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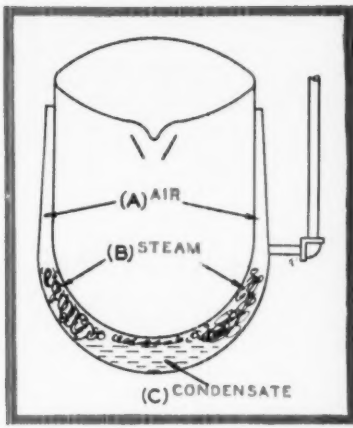

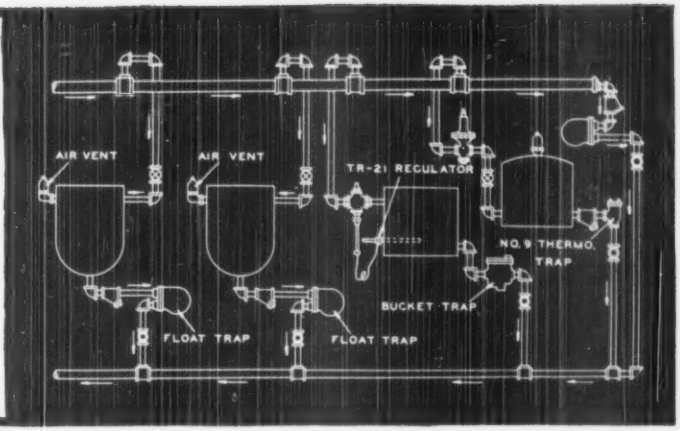

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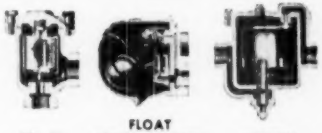
Simple as ABC

A. Air and other gases in steam lines or equipment not only reduce the effective temperature of the steam, but create insulated cold spots wherever there is an accumulation. These gases are constantly generated in the boiler and air is always present when starting up. Ask for Bulletin No. 275 (Air in Steam).

B. Dry steam can be delivered at the point of use only by trapping condensate from mains, risers, coils, etc. The amount of steam and therefore the temperature of the room, process, press, tank or oven, can be controlled to within a degree or two by selecting suitable Sarco Temperature Controls.

C. The speed of the work can be maintained and fuel efficiency insured at top level by removing condensate with the right Sarco Steam Trap based on calculations and recommendations given in Sarco Bulletin No. 1600.



No. 9 — FLOAT THERMOSTATIC — BUCKET

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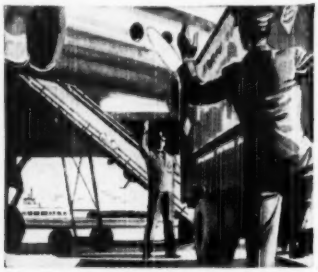

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all literature to find the attendant difficulties and weaknesses uncovered by earlier investigations. With this as a background the liquids were subjected to pressures of 10,000 psi at temperatures up to 200 F for the hexamethyldisiloxane and to 300 F for the octamethyltrisiloxane. The densities reported are held to be precise within 0.3%. *ASME paper No. 49-A-91.*

WATER TREATMENT

THE INDUSTRIAL APPROACH TOWARD WASTE TREATMENT AND STREAM POLLUTION ABATEMENT, *by H L Jacobs, E I du Pont de Nemours & Co.* The stream pollution-abatement movement has become national in scope and of general interest. Industry is responsible for a portion of the pollution and is under obligation as a "good neighbor" to take corrective steps. Industrial management must be sold on the needs and merits of pollution abatement before real progress can be made.

Ready-made recovery or treatment methods can seldom be applied to industrial waste problems, and extensive experimentation is usually necessary. Facilities for analytical work and competent personnel are required for successful solution of a waste problem. Emphasis should be placed on waste elimination at the source, recovery of wastes and process changes that reduce or eliminate wastes. Waste treatment sometimes proves the only practical answer and such methods should be tested at the pilot plant level.

Cooperation with pollution control agencies is both desirable and profitable. Development of mutual confidence between the industry and the agency helps in the task of developing an acceptable abatement method. The public relations aspect of the pollution abatement problem should receive adequate attention.

The organization evolved by the du Pont Co in solving pollution problems is discussed. *ESWP paper. No number.*

CHEMICAL QUALITY OF INDUSTRIAL SURFACE WATERS OF PENNSYLVANIA, *by W F White, assistant chemist, U.S. Dept of the Interior, Geological Survey.* In cooperation with the Pennsylvania State Planning Board, the Geological Survey has been collecting data on the chemical quality of surface waters in Pennsylvania since 1944. Purpose of this investigation is to determine the characteristic behavior of streams in response to the many factors affecting the occurrence of water in the watershed. The chemical analyses and a record of changes in chemical quality that occur with time help make it possible to

The time to think of

OPERATING COSTS

is When You Buy a Steam Plant

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Not for today alone . . . nor for the next few months . . . but for **years** to come . . . your Superior Steam Generator will continue to generate low-cost steam at high efficiency. Based upon long years of combustion engineering experience, its design embodies features which assure maximum long-run economy; for power engineers are well aware of the fact that an inefficient boiler can waste more than its cost in a few years.

Its rugged, heavy-duty construction is visible evidence of its long-lived dependability; for Superior's greater weight per boiler horse power, and larger heating surfaces contribute measurably to long-run economy . . . assuring performance at capacity ratings year after year after year.

Unlike the car you drive . . . which you trade in for a new model every few years . . . steam generators should be built to give long years of satisfactory service. Make sure that the steam generator you buy has the features which insure both long life **and** economy.

Look for fully automatic operation with any grade of oil . . . or gas . . . for fully automatic operation is truly an economy. Look into Superior's built-in induced draft. Compare heating and evaporating surfaces. Compare both size and weight.

Then see a Superior installation and observe the little details . . . wiring, fittings, its own specially designed burner, and last of all, its sturdy construction.

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Get *positive* protection with Strong's Combination Separator and Trap!

Spray guns, air chucks, fixtures and other air-using equipment, *must* be kept free of water and oil for best results. Strong's Combination Separator and Trap will completely separate all liquids from air (or steam) and automatically discharge them.

CHECK THESE FEATURES:

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★ No cleaning required;
★ Copper-clad steel float (stainless steel at additional cost);
★ Anum-Metl seat and disc—guaranteed leakproof for one year;
★ Sizes from ½ to 1½ inches, screwed; pressures to 250 psi.

Other products in the *complete* STRONG Steam Specialties line include steam traps, strainers, separators, pressure regulators and continuous blow-down valves. For complete information, write for your copy of our new Catalog No. 68 today, or see one of our nearly 200 distributors.

STRONG, CARLISLE & HAMMOND COMPANY

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Cleveland 13, Ohio

ANUM-METL Reg. Trade Mark

evaluate the usefulness of a river water for industrial purposes.

Lowest concentrations of dissolved solids are found in waters in the upper Delaware River basin and in parts of the Susquehanna River draining the north central portion of the state. Highest concentrations of dissolved solids and greatest variations in quality occur in streams draining coal mine areas and highly industrialized districts. In general, calcium, magnesium and bicarbonate are the principal dissolved ions in the waters. In many of the river basins, acid mine drainage tends to reduce the bicarbonate concentration and greatly increase the sulphate concentration.

Latter part of paper presents data about the wide variation in chemical quality of cross-section samples collected from Susquehanna River at Harrisburg. It points out the necessity for taking into account the possibility that a single water sample may not represent the entire cross section of a river at the sampling location. *ESWP paper. No number.*

WATER PROBLEMS IN STARTING OF MITCHELL POWER STATION OF THE WEST PENN POWER CO, *by W L Thompson, chemist, Mitchell Station, West Penn Power Co.* This paper describes the water problems encountered and their solution in starting up Mitchell Power Station, West Penn Power Co. at Courtney, Pa.:

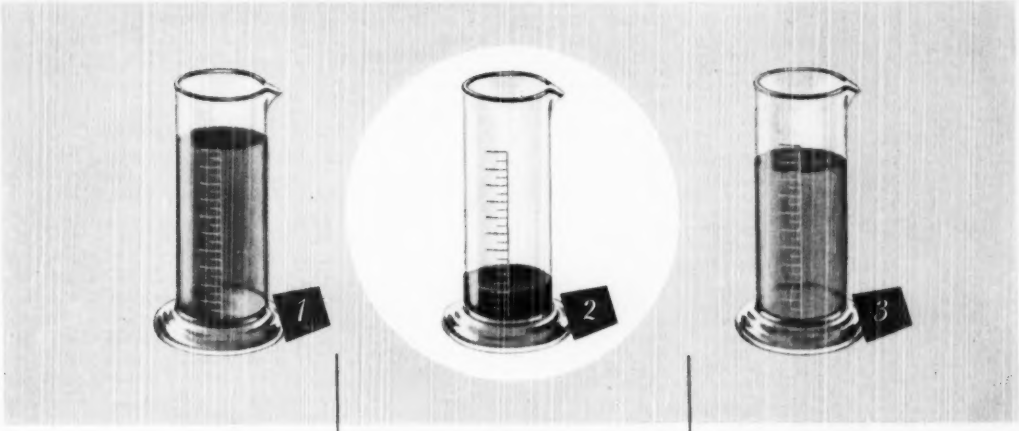
The problems divide into four parts:

1. Starting up and operation of the water-treating plant.
2. Boiling out and starting up of No. 1 boiler and No. 1 main unit.
3. Conversion of the boiler-water system from softened water to distilled water.
4. Boiling out and placing in service of No. 2 boiler.

Solutions of each of these basic problems make up much of the paper's content. Some of the steps are of particular interest to the plant involved. The general treatment and approach, however, is of value to all power-plant operators. *ESWP paper. No number.*

THE PROBLEM OF GENERATING PURE STEAM AT HIGH PRESSURES, *by Martin Frisch, vice-president, and R A Lorenzini, mechanical engineer, Foster Wheeler Corp.* Sustained, troublefree operation of high-pressure steam turbines makes the generation of pure steam a necessity. To accomplish this over a wide range of gage-glass levels, boiler-water concentrations and ratings, the drum internals must provide steam-free water as well as water-free steam. The water must be steam free for maximum circulation and minimum drum

How Alchlor Process "Remove-ability"* gives Gulfcrest Oil its greater stability



In Cylinder 1 you see the oil that will become Gulfcrest. It has gone through the usual steps used in refining most other turbine oils—but has not yet been Alchlor-processed — an extra refining step that makes it extra pure and extra efficient.

*In Cylinder 2 you see the part—as much as 15%—which is discarded by the Alchlor Process. This is the part that, in ordinary turbine oils, is most likely to oxidize, increase neutralization number, and form sludge, emulsifiers, and acids.

In Cylinder 3 you see the finished Gulfcrest—the incomparably pure lubricating oil that gives outstanding performance and helps you keep steam turbine systems clean indefinitely. To make it even finer, special inhibitors are added to it.

Call in a Gulf Lubrication Engineer today and ask him to recommend the proper grade of Gulfcrest Oil to meet the specific requirements of your turbines. Write, wire, or phone your nearest Gulf office.

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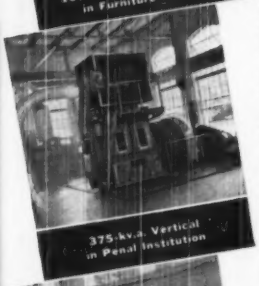
SKINNER "UNIVERSAL UNAFLOW"

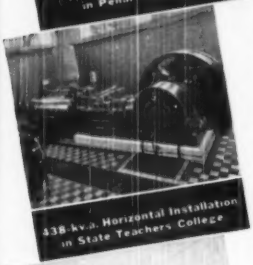
STEAM ENGINES

HAVE BEEN MEETING INDUSTRY'S DEMAND FOR DEPENDABLE, ECONOMICAL ELECTRIC POWER

1000-kv.a. Horizontal Unit in Furniture Factory

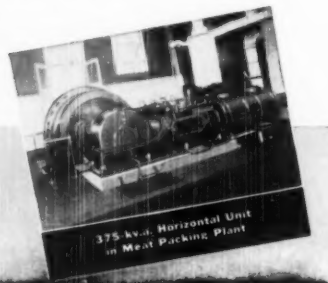


375-kv.a. Vertical in Penal Institution



438-kv.a. Horizontal Installation in State Teachers College

750-kv.a. Vertical in State Welfare Institution



375-kv.a. Horizontal Unit in Meat Packing Plant

EXPERIENCE

For over three-quarters of a century, doing one thing well—building steam engines. This plant is the largest in the United States devoted exclusively to the building of steam engines, and the Skinner organization has justly acquired the reputation of being steam engine specialists.

THE "UNIVERSAL UNAFLOW"

The "Universal Unaflow" was the first American poppet-valve unaflow engine, and has earned popular recognition as "the most economical steam engine built." More "Universal Unaflow" engines have been built than all other American unaflow engines combined.

Two thousand power users, in industries and institutions of various types, have found it more economical to generate their own electric power with Skinner "Universal Unaflow" Steam Engines than to purchase power from the local utility, or to generate their power with other prime movers.

ADAPTABILITY

Suitable for noncondensing or condensing operation, with automatic change for either condition. Also may be built for constant or variable back pressures; medium or moderately high initial pressures, saturated or superheated steam.

MAINTAINED ECONOMY

Maintained economy is guaranteed, and is due to patented design of the poppet inlet and auxiliary exhaust valves, which are steam-tight after long use and under any variation of steam pressure or temperature. Steam consumption guaranteed subject to test after six months' operation, with final payment withheld until after test.

HORIZONTAL ENGINES

In general use for direct connection to electric generators, refrigeration equipment, compressors, blowers, pumps, etc. Special manual or automatic controls for variable speed and load requirements.

VERTICAL ENGINES

For limited space, or where other conditions make a vertical engine preferable, the stationary "Universal Unaflow" is offered in multi-cylinder vertical type, embodying the same fundamental economy and design features as the horizontal. Multi-cylinder vertical "Universal Unaflow" assemblies also extensively used for variable-speed compressor drive.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

swell. Excessive drum swell affects steam purity adversely.

This paper shows how gage glass error or drum swell may be minimized. Results of tests showing the effects of steam entrainment on circulation and drum swell are cited, and the comparative effectiveness of various water desteaming arrangements are given. The paper also considers the problem presented by solutes, which become vaporized or dissolved in the steam at high pressures and which cannot be removed by mechanical means alone. Effectiveness of steam washing and stage evaporation for reducing the concentration of these solutes in the steam is analyzed. It is shown that where makeup is high, and silica in the makeup is high also, silica in the steam may be reduced to very low values through the use of the dual-circulation boiler. This embodies the principle of stage evaporation. *ESWP paper. No number.*

Plant Problems

(*Continued from page* 126)

Apparently *CK* is primarily interested in converting a gasoline engine to a single-stage air compressor, overlooking over-all efficiency.

In addition, I should like to emphasize that an after-cooler is valuable in removing heat of compression. It is also effective in removing moisture. Air receiver would eliminate pulsation and also act as a reservoir during intervals if and when the air demand exceeded compressor capacity.

CARL BACHMANN
Williston Park, N.Y.

OK in an Emergency

MY FIRST EXPERIENCE in the use of an automobile engine as an air compressor was with two model-T Ford engines, direct connected, one as a compressor and the other as power source. This set was depended on for the air supply in the spraying of fruit trees in a commercial orchard. No receiver or valves were used. Air was collected in a 4-in. manifold from $\frac{1}{2}$-in. pipes screwed into the spark-plug holes, and air backflow was prevented by a check valve in each branch to the manifold.

Air was delivered by hose from manifold to the barrels of spray solution. Water was circulated through both driving and driven engines and cooled by radiators and fans. No other air cooling was attempted. Tests showed pressures as high as 120 psig.

Later, in plant service, I used this same idea with an electric motor belt-connected as the source of power. Here I set the engine on a frame anchored to the floor and piped city water through the jacket for cooling. Since some of

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TUBE-TURN

WELDING FITTINGS AND FLANGES

He handles the firmly established, quality brand of welding fittings and flanges. He handles a wide range of types and sizes. He carries a big stock. He knows piping. He is close at hand. For his address, write, wire, or phone your nearest Tube Turns' district office.

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Houston: 1704 Commerce Building, Charter 1668
Los Angeles: 447 General Petroleum Building, Madison 6-3219
New York: 150 Broadway, Rector 2-7844
Philadelphia: Broad Street Station Building, Rittenhouse 6-0722
Pittsburgh: 3001 Grant Building, Atlantic 1-8848
San Francisco: 2611 Russ Building, Garfield 1-2594
Tulsa: 317 South Detroit Avenue, Telephone 2-9193

TUBE-TURN SEAMLESS WELDING FITTINGS — RANGE OF SIZES

DESCRIPTION	STANDARD WEIGHT	EXTRA STRONG	SCHEDULE 160	DOUBLE EXTRA STRONG	LIGHT GAUGE NOMINAL PIPE SIZE	LIGHT GAUGE IRON PIPE SIZE
ELBOWS—90° Long Radius	½"-24"	½"-24"	1"-12"	½"-8"	4"-24"	½"-12"
ELBOWS—90° Short Radius	1"-30"	1½"-30"				
ELBOWS—45° Long Radius	½"-30"	½"-30"	1"-12"	½"-8"	4"-24"	½"-8"
RETURNS—180° Long Radius	½"-24"	½"-24"	1"-12"	2"-8"	4"-24"	½"-12"
RETURNS—180° Short Radius	1"-30"	1½"-30"				
RETURNS—180° Extra Long Radius	1"-21½"	1"-21½"				
TEES—Straight	½"-24"	½"-24"	½"-12"	½"-8"		
TEES—Reducing Outlet	½"-24"	½"-24"	½"-12"	½"-8"		
REDUCERS—Concentric and Eccentric	½"x½"-24"x24"	¾"x¾"-28"x20"	¾"x¾"-12"x10"	½"x½"-8"x6"		
CAPS	½"-24"	½"-24"	1"-12"	1"-8"		
STUB ENDS—Lap Joint	½"-24"	½"-24"				
SADDLES	2"-24"**					
LATERALS—Straight	1"-24"	1"-24"				
LATERALS—Reducing on run	1"-24"	1"-24"				
CROSSES—Straight and Reducing	½"-24"	½"-24"				
RINGS—Welding, Grove Type	½"-24"	1"-24"		1"-8"		
RINGS—Welding, Ridge Type	½"-12"	½"-12"				
SLEEVES—Welding	2"-24"**					

** Since saddles and sleeves are for external reinforcement only, they do not conform to iron pipe size thicknesses.

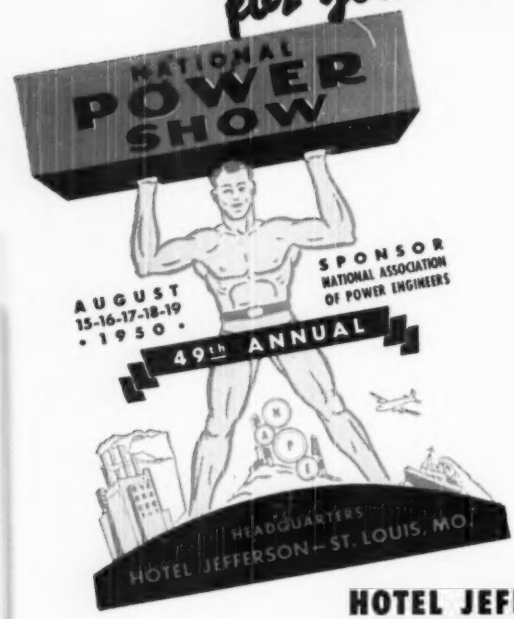
TUBE-TURN FORGED STEEL FLANGES — RANGE OF SIZES

DESCRIPTION	150 LB.	300 LB.	400 LB.	600 LB.	900 LB.	1500 LB.	2500 LB.
WELDING NECK	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"	½"-24"	½"-12"
SLIP-ON	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-12"
LAP JOINT	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-12"
THREADED	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-12"	½"-12"
BLIND	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-12"
SOCKET TYPE	½"-24"	½"-4"	½"-3½"†	¼"-2½"			
REDUCING—Threaded or Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"	½"-12"	½"-12"
ORIFICE—Threaded		1"-24"	4"-12"	4"-12"	1"-12"	1"-12"	
ORIFICE—Slip-On		1"-24"					
ORIFICE—Welding Neck		1"-24"	4"-12"	4"-12"	1"-12"	1"-12"	1"-12"

† Dimensions on sizes thru 3½" same as for 600 lb. flanges.
* Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

In addition to carbon steel welding fittings and flanges listed here, the complete Tube-Turn line embraces many other metals and alloys—types 304, 347, and 316 stainless steel, carbon moly and chrome moly steels, copper, aluminum, brass, Monel Metal, Inconel, nickel, wrought iron. Ask your Tube-Turn distributor for catalogs and other reference material.

Here's THE 1950 National MARKET PLACE for Your Products



HOTEL JEFFERSON
ST. LOUIS, MO.
AUGUST 15-16-17-18-19

Plan now to exhibit and sell your products at the 49th Annual National Power Show. Thousands of engineers will be there who buy, specify and recommend power production, power generation, power transmission and materials handling equipment, materials, supplies and services.

Many exhibitors signed up for the 1950 show before the 1949 show closed. The 49th Annual Show is certain to be a "sellout." Write today for floor plan so you can place your reservation at once. Space is assigned in order of receipt of reservation agreements.

These Exhibitors Have Already Reserved Space for the 1950 Show

Armstrong Machine Works
Babcock & Wilcox Co.
Bushnell Packing Company
Chicago Faucet Company
Combustion Engineering—Superheater, Inc.
Dearborn Chemical Co.
Dowell, Inc.
Electric Auto-Lite Co., The
Fairbanks, Morse & Co.
Garlock Packing Co.
Green, A. P., Fire Brick Co.
Jefferson Union Company
Link-Belt Company
Livingstone Engineering Co.
Lunkenheimer Company
Milwaukee School of Engineering
Otis Elevator Company
Perfex Corporation
Pilbrico Jointless Firebrick Co.
Power & Operating Eng. —McGraw-Hill
Ramtite Co., Div. of Obermayer Co.
Roebling's, J. A., Sons Co.
Schaub, Fred H., Eng. Co., Inc.
Sexauer, J. A., Mfg. Co.
Sinclair Coal & Southern Coal
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Show them . . . Sell them . . . with a *Power Show* Exhibit

ASK FOR REGISTRATION ANALYSIS

A nine page statistical analysis of attendance at the 1949 National Power Show will be sent on request. This analysis breaks down the thousands of registrations by state, city and foreign countries; by position and executive title, and by industry. This registration analysis *proves* that every manufacturer who serves the power field will profit by exhibiting in The 49th Annual National Power Show to reach this valuable audience of customers and prospects.

Wire or telephone
JOHN C. TOOHY, *Exhibit Manager*
NATIONAL POWER SHOW
Suite 1532, 176 West Adams Street
Chicago 3, Illinois
TELEPHONE Randolph 6-8298

this air was used for blowing out motor windings I installed a receiver to take out oil and water, and stabilized the pressure at 35 psig. I improved unit efficiency by filling ignition chambers with lead, and drilling holes through the lead to the pipes.

While such makeshift outfits may be useful for occasional jobs, plant efficiency and tidiness dictate the use of an air compressor designed along lines of modern engineering practice.

GEORGE HOLMAN *Decatur, Ill.*

It Won't Pay

CK SHOULD STEER CLEAR of auto engines converted to air compressors. Conversion, while possible, is not sound practice from either the economic or safety standpoint. Insurance firms would need a great deal of proof before they would be satisfied that he had properly and safely solved the piping, lubrication, cooling and condensate problems always associated with air-compressor safe operation.

A standard air compressor can be a definite hazard when not given sufficient attention; a converted auto engine would be a hazard from the start because it does not possess the essential design characteristics necessary for operation.

CK would be far better off if he purchased an air compressor from the units listed in POWER's Searchlight Section. The unit would have a moderate first cost, could be easily insured, and would have a much longer life with less maintenance and attention than a converted auto engine. Conversion might appear economically justifiable when all the equipment is on hand. But a few months' operation of the unit would show that half a machine can be worse than none at all.

TYLER HICKS *Summit, N.Y.*

National Association of Fan Manufacturers, Inc, is the new name of a well-known trade association. NAFM was organized Feb 7, 1917 as a voluntary association under the name of Fan Manufacturers' Credit Assn. By 1919 its name was changed to NAFM to indicate its functions more closely. In September 1949 it was incorporated under the laws of the State of Michigan.

Frederick Flader, president of Frederick Flader Co and Flader-Clark Co, of North Tonawanda, N. Y., announces that his two firms are signing a long-term lease for the U. S. Air Force plant in Toledo, Ohio, which was formerly operated by Packard Motor Co. Laboratory of the plant will be operated by Frederick Flader Co, which is engaged in research and development of gas turbines, jet engines, compressors and electronic equipment. Flader-Clark Co, a manufacturing concern, will use factory space at the Toledo plant.

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A.O. SMITH is the only Vertical Turbine Pump Manufacturer making all major pump parts in its own plants...

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Only A. O. Smith makes all major parts of vertical turbine pumps—your assurance of unsurpassed quality control, precision fitting, years of dependable low-cost service, and one source of undivided responsibility.

Seventy-five years of experience are back of the research and engineering A. O. Smith has built into SMITHway Pumps—in improved impeller design . . . precision pump assembly . . . sturdy, long-lasting construction.

MAXIMUM ADAPTABILITY. A. O. Smith Pumps are available with A. O. Smith Vertical Hollow Shaft Electric Motors, flat pulley or V-belt pulley, and right-angle gear drive. You can choose either water or oil lubrication.

STEEL WHERE STEEL BELONGS. Discharge-head assemblies of A. O. Smith Pumps are heavy *steel plate,* formed and welded into the strongest, most compact design. Driver support is rigid, vibrationless, yet easily accessible. In the heavy, cast-iron, precision-machined bowls, either semi-open or enclosed type bronze impellers are available.

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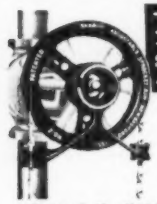

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SPROCKET RIM
with Chain Guide

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STEP-LADDER
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• Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 10 inches.

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• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

• *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

BABBITT STEAM SPECIALTY CO.

1 Babbitt Square, New Bedford, Mass.

NEW EQUIPMENT

(Continued from page 144)

tating wall. In the time required for the gas to travel the length of the tube a higher percentage of fines than heretofore can be pulled out of the gas stream. The center outlet tube has been reduced in size to match more closely the dust-free vortex produced by the whirling gas.

When several tubes are nested together they are placed close enough so their sides form the inlet channel for incoming gas. The path the incoming gas travels is in the shape of the letter S.

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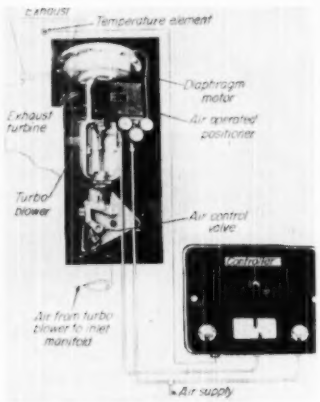
Stoncote may be applied to all maintenance areas by brush or spray. It dries in from one-half to one hour under ordinary temperatures.

Stonhard Co, Dept P, 1306 Spring Garden St, Philade'phia 23, Pa.



P1247 • DUAL - FUEL IMPROVEMENTS—Dual-plunger fuel pump and automatic thermal air control, now standard equipment on Worthington dual-fuel diesels, provide greater efficiency and smoother operation over a wide load range, it is claimed.

The dual-plunger fuel pump has a small-diameter pilot plunger mounted in tandem with the main plunger for full load operation on oil fuel. The separate small plunger supplies the pilot oil for burning gas fuel. This design gives improved atomization of pilot fuel, with short, localized penetration into the combustion chamber. The result, it is claimed, is lower firing pressure, with reduced exhaust temperature and improved fuel consumption.

The automatic thermal air control (*illustrated above*) provides correct fuel-air ratio at all times and in direct relation to load changes. The most responsive medium — engine exhaust temperature actuates

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No. 6

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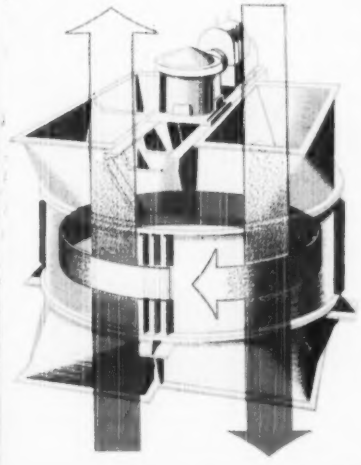
LJUNGSTROM



The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of leading power plants and other special applications confirm its high level of heat recovery and long-term low maintenance service.

THE

AIR PREHEATER CORPORATION

60 EAST 42ND STREET · NEW YORK 17, N. Y.

Plant: Wellsville, N. Y. 2879

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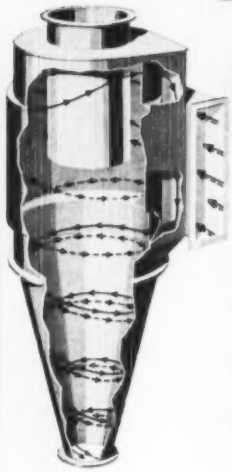

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this control. Daily and seasonal changes in ambient air temperature can be compensated for by simple, quick adjustment. **Worthington Pump and Machinery Corp, Harrison, N. J.**

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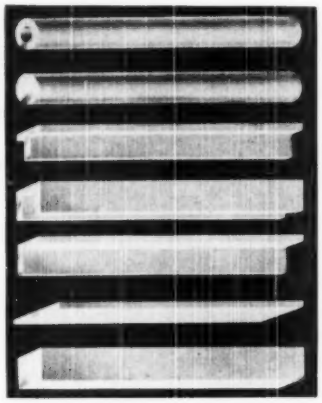
Compact, totally enclosed-unit air-conditioning system available in a range of sizes controls temperature and humidity from 1000 to 20,000 cfm of air at room temperature.

Air enters the casing under the pull of fans. It is filtered and passed through a spray of *Hygol*, a patented chemical that absorbs the air-borne moisture. Cooling coils follow up to remove the latent heat of evaporation and any sensible heat that may be needed. Air then continues on through moisture eliminators to final discharge.

The absorbent liquid spray falls back into a tank at the base. It is piped from here to a concentrator which takes the moisture removed from the air out of the absorbent liquid. Reconcentrated *Hygol* returns to the system.
Niagara Blower Co, 425 Franklin St, Buffalo 2, N. Y.



STANDARD CASTINGS P128

New method permits stocking and packaging standard shapes and forms of Meehanite castings—a metal produced to bridge the gap between cast iron and steel.

All shapes are 12 in. long and can be

A JOY Axivane Fan in a commercial store—chosen for its low noise level, compactness, and simple and easy installation.
the JOY AXIVANE® FAN
Mounts Right in the Air Duct—
Saves space, installation costs, gives you quieter, more efficient ventilation!
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GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.
IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

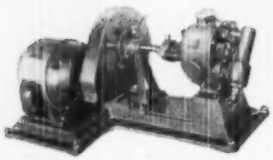

Fig. 12
FUEL OIL TRANSFER PUMP

For smooth, efficient handling of all types of clean liquids, there is a Viking pump built in the size and style to meet your needs.

Viking pumps are especially built for bearing lubrication, fuel oil transfer and cooling water service.

VIKING
AN HONORED NAME IN PUMPING

Ask for free bulletin 2201W.

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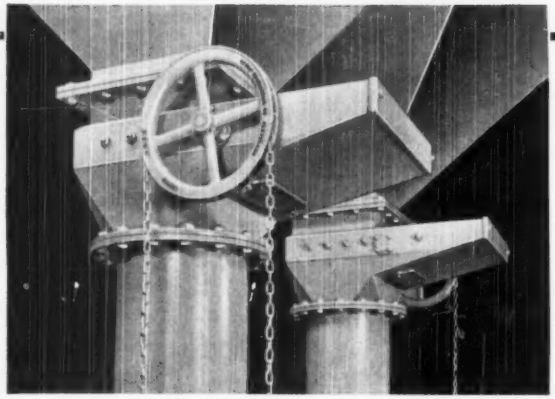
Viking PUMP COMPANY
Cedar Falls, Iowa



S-E-CO. COAL VALVES are equipped with operating chain of a size and shape to fit the hands of the operators. S-E-Co. Hand Chain was selected not for low cost but rather for a type which operators would find comfortable to grasp. This chain is but one of the features that make S-E-Co. Coal Valves superior.

Send inquiry to

STOCK ENGINEERING COMPANY
715P Hanna Building ★ Cleveland 15, Ohio

had in sizes from ¼ to 12 in. for squares and flats, ¼ to 18 in. for rounds and bushings, 1 to 18 in. for angles, channels and tees, with ⅛-in. allowance on all dimensions for finishing. Castings have a tensile strength between 30 and 50,000 psi, combined with no porosity and fast machinability.

Motors & Metals Inc, 220-4 West 42nd St, New York, N. Y.

VOLTAGE REGULATOR **P160**

Type *ML-8* step-type voltage regulator provides a total of 10% regulation in eight 1¼% steps. Unit is available in selected kva sizes in 2500-, 5000- and 7620-volt ratings and corresponding Y-connected voltages.

Other features include an improved tap-changing switch, cover bushings with clamp-type terminals on all ratings. There is also a "load-bonus" feature that permits increase in current-carrying capacity up to 160% for the connection arrangement of 5% raise to 5% lower.

General Electric Co, Schenectady, N.Y.

SLIDE RULE **P114**

A new double or back-to-back scale on the *809 Log Log* slide rule simplifies the traditional scale arrangement. The new scale (1) places the six log-log-mated scales together to make three double scales with numbers and reciprocals back-to-back (2) provides the extra area for placing *C* scales on both sides (3) includes the *DI* scale, often left off.

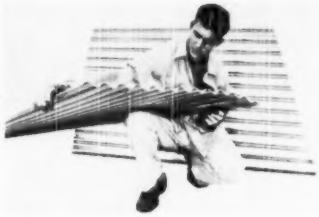
Pickett & Eckel, Inc, 5 South Wabash Ave, Chicago, Ill.

WATER TREATMENT **P134**

Phosphate Poly Preparations meet specific requirements for small and medium-sized steam plants.

Preparations include (1) alkali-controlling agent (2) softening chemical (3) organic colloidal materials (4) corrosion inhibitors (5) antifoam agent.

The Brooks Boiler Treatment Co, 3304 E 87th St, Cleveland 4, Ohio



TAILOR-MADE ROOFING **P109**

Off-the-job, tailor-made roofing and siding fabricating service for corrugated metal or asbestos saves roofing materials and on-the-job labor costs.

Material supplied is *Alcoa's* deeply corrugated 0.032-in. aluminum previously available only in warehouse stock sizes. This roofing material has been specially designed to take purlin spacing and loading comparable to corrugated asbestos or

The most resounding compliment an operating man can pay a sales engineer is contained in those simple words. When you say "he knows his way around" you mean in no uncertain terms that someone has gotten right down to business and wiped out one of your problems.

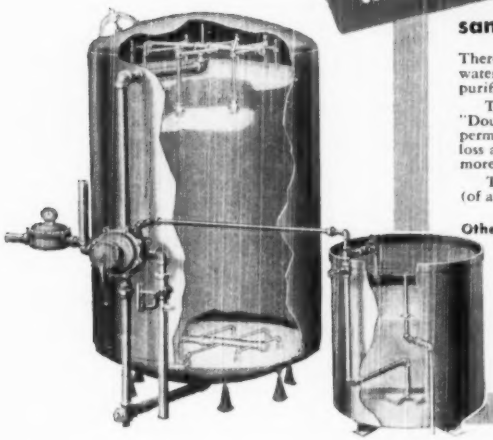
Those words are the sweetest music that comes to our ears when we go into a plant and show an operating man the straight, low-cost route to a complete solution of his water conditioning problem. Thousands have said it of the Elgin organization; you will say it too . . . and we'll tell you why:

Elgin knows its way around because we have tusseled with just about every conceivable water conditioning problem . . . because we have explored every method that can be properly applied to any problem . . . because we have available every authoritative method.

Unlike the man who deals with only one or two methods, the Elgin man can select the *best* method from all methods. That's why he can choose the method that fits your condition, instead of trying to convince you that your condition fits *his* method! There is no cost or obligation whatever for a complete check-up of your conditions and a concrete recommendation from the organization that is so widely acknowledged to know its way around. Write today for facts about an Elgin survey.

ELGIN SOFTENER CORPORATION
130 N. Grove Ave., Elgin, Ill.

ELGIN
ECONOMICAL WATER CONDITIONING



Up to 44% more soft water per regeneration—from the same size softener using same type of zeolite

There you have the proof that Elgin knows its way around in the zeolite water softening field, just as in the fields of chemical treatments, filters, purifiers, and other water conditioning methods and equipment.

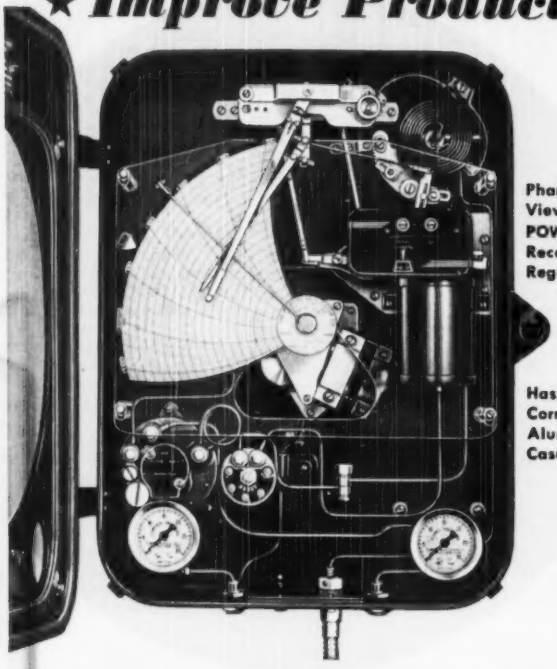
The open secret of this greater, zero-soft water output is the Elgin "Double-Check" manifold design which prevents escape of zeolite; thus permits using more zeolite in a tank of given size. Prevention of zeolite loss also permits faster, more thorough back-washing. Over-all result is more soft water, from a smaller softener, at lower cost.

The "Double-Check" system can also be installed in existing softeners (of any make) with these same remarkable results.

Other Elgin water conditioning methods and equipment include:

- Boiler feed water treatments
- Post treatments for softened water
- Corrosion prevention in steam systems
- Corrosion prevention in hot and cold water piping
- Filters and purifiers
- Boiler sludge removal (Deconcentrator) systems
- Iron removal equipment
- Aerators and Degasitors
- Chemical feeders
- Water testing equipment
- Zeolites of all types

★REDUCE COSTS
★Improve Production



Phantom View of POWERS Recording Regulator

Has Non-Corrosive Aluminum Case

with precision control by—

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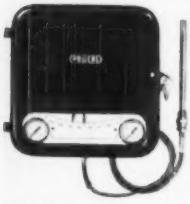
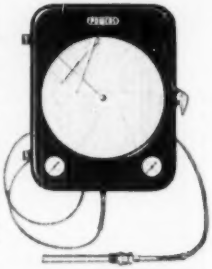
Air-Operated
INDICATING AND RECORDING REGULATORS

For TEMPERATURE • HUMIDITY • PRESSURE

End losses caused by OVER-heating of processes or operations requiring precise control. Install POWERS pneumatic regulators. Their accurate control helps to improve quality of products—speed up production and save steam wasted by overheating.





Variety of Models: Recording Thermometers; Recording Regulators; Indicating Regulators; Wet and Dry Bulb Recording Regulators; Time Cycle Recording Regulators; Master and Sub-Master Indicating and Recording Regulators, etc. *Write for Bulletin 370.*

For Better Temperature and Humidity Control and valuable aid in selecting the right instruments for your requirements—phone or write our nearest office. There's no obligation. The Powers Regulator Co., 2737 Greenview Ave., Chicago 14, Ill. • 231 E. 46th St., New York 18, N.Y. • 1808 W. Eighth St., Los Angeles 5, Calif.

(102)

THE POWERS REGULATOR CO. • OFFICES IN 50 CITIES

protected metal. The aluminum is said to keep buildings cooler because it reflects 95% of the sun's heat rays.
Childers Mfg Co, 625 Yale St, Houston, Texas.

PORTABLE VACUUM CLEANER P115

Shoulder-sling carry permits easy two-hand operation of portable, 7 to 16 lb, *Tornado* vacuum cleaner.

Equipment comes in four sizes with drives of 1/3, 3/5, 1 and 1 1/3 hp universal motors having permanently sealed bearings. Air intakes and suction openings can handle from 53 cu ft of air per minute for the smaller models up to 86 cfm in the 1 1/3-hp unit.
Breuer Electric Mfg Co, 5100 Ravenswood Ave, Chicago 40, Ill.

BRAZING ROD P105

Flux-coated, nickel-silver brazing rod, *All-State No. 11*, can be used with oxy-acetylene blowpipes.

New rod has been tested on 14 different metals, and its selection applies wherever bronze is used. It brazes with higher strength—tensile about 85,000 psi, shear above 160,000 psi—and full machinability with less alloy. There is no fuming or glare when it is used.
All-State Welding Alloys Co, Inc, 273 Ferris Ave, White Plains, N. Y.

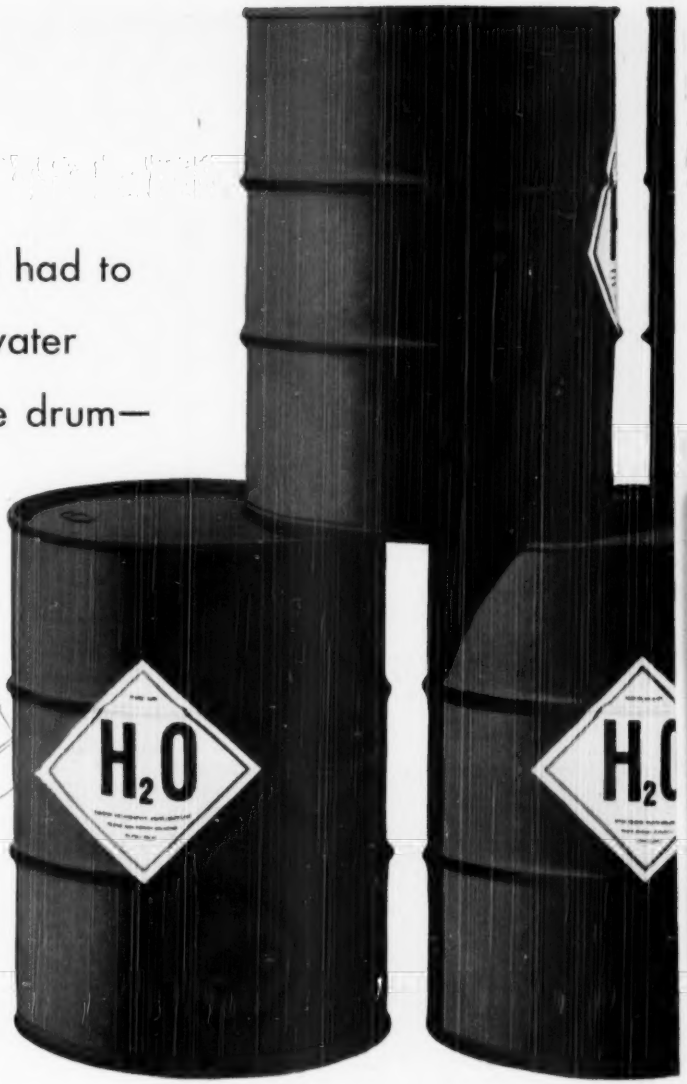
GAS BURNERS P110

Any combustible mixture of gas can be burned over a wide range of mixture pressures from 0.1 in. of water to 1½ psi with *Pyronic* tunnel gas burner.

Available in capacities from 6000 to 1,660,000 Btu per hr, burner operates without special adjustment anywhere in the 450-3100 Btu gas range. Because of the wide mixture pressure allowances, the burner can serve with a low turn down or high pressure for high temperature duty.

The long annular port, photo above, reduces backfire problems and turbulence at

If you had to buy water by the drum—



IF WATER were delivered in drums, it would be more easily recognized as what it is today—an important and not-too-plentiful raw material.

Like other materials used in the manufacture of your product—and that product may be anything from steam to steel—water must be adapted to the purpose for which it is used, and to the processes employed. It must be used economically and efficiently, valuable constituents remaining in the water after use must be salvaged, and waste must be disposed of at minimum cost and without detriment to the rights of others.

Water is a plant-wide problem, and Hall Laboratories offers plant-wide service, covering any and all water problems from selection of sources to ultimate disposal of waste.

May we send you a copy of our bulletin "Water Problems neither begin nor end at the boiler"?

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HALL *plant-wide* WATER SERVICE

INDUSTRIAL WATER TREATMENT...BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

GE LEAK DETECTORS

find leaks quickly

With G-E leak detectors you can easily locate even the smallest leaks in closed systems. Detectors are ideal for locating leaks in installed equipment or in the products you make.

Use the Type H detector for pressure systems, the Type M for evacuated systems.* Write for Bulletin GEC-233 (Type H) or for GEC-336 (Type M). *Address Apparatus Dept., N687-21, General Electric Co., Schenectady 5, New York.*

**If the system is filled with combustible gas, write for special application information.*

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industrial
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McKEES ROCKS, PA. (Pittsburgh District)

the port so the burner can light off easily. An accessory reversible flange and mounting bracket provides five different mountings to fit burner to furnace walls from 4 to 16 in. thick.

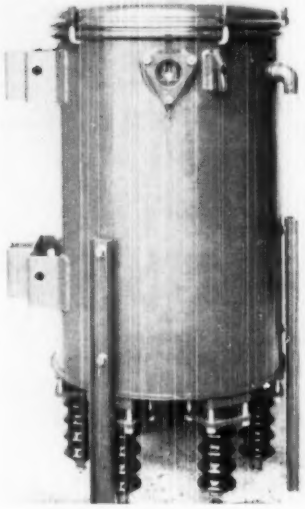
Bryant Industrial Div, Affiliated Gas Equipment, Inc, 1020 Louden Rd, Cleveland 10, Ohio.

CABLE-SPLICE HOUSING **P167**

Plastic housing eliminates lengthy outside wrapping operations to join lengths of electrical cable. Main structural-part housing is a pipe made from a tough, corrosion-proof blend of synthetic rubber and thermoplastic resins. It is recommended for both aerial and underground installations and can be used with either rubber or neoprene cable.

This pipe fits over the cable joint. Two rubber seals are used in the pipe to make it moisture-tight. Threaded plastic caps on each end of the pipe grip the cable and insure a tough, finished joint.

U.S. Rubber Co, Rockefeller Center, New York 20, N.Y.



CAPACITOR SWITCH **P135**

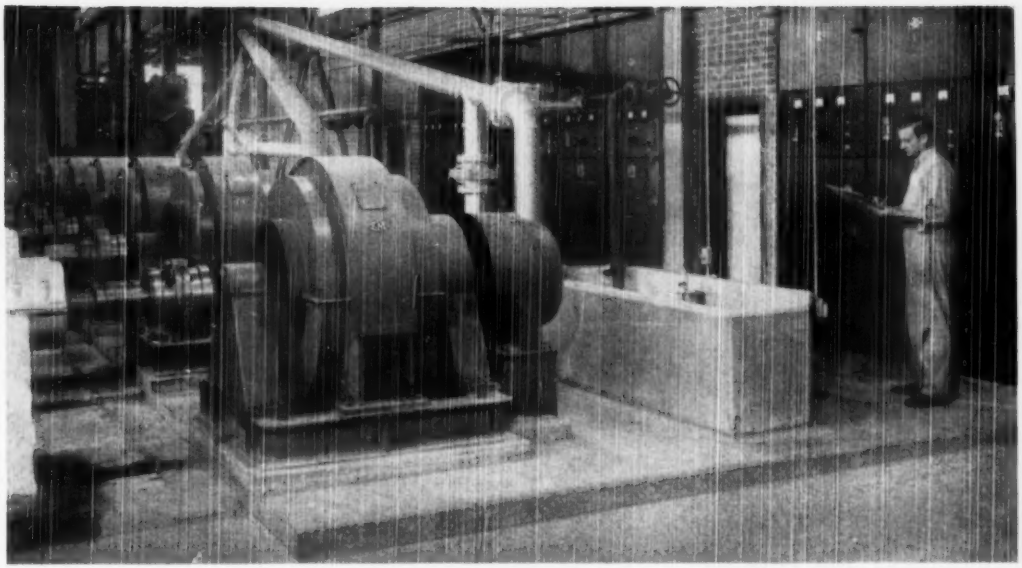
Rated 15-kv, 110-amp continuous, 3 phase, the B-1 capacitor switch is oil-immersed, electrically operated and constructed for outdoor use. This switch supplants more expensive switching devices that were used on other types of equipment as well as capacitors.

Primarily intended for pole mounting, the switch can be supplied as a component part of housed capacitor equipments if desired. It is capable of switching its continuous current, 100 amp, at 15 kv.

General Electric Co, Schenectady 5, N. Y.

PUMP PLUNGER GUIDE **P143**

For use on single, double and triple-plunger sludge pumps this crosshead guide rod is rigidly secured to each plunger. The



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● Top motor performance with complete safety to men and motors—that's what Michigan Carton Company *wanted* for its new plant having the world's longest paper boxboard machine. And that's exactly what this Battle Creek Company *got* when E-M Hi-Fuse Synchronous Motor Controls were installed for the jordan and hydrafiner motors that help make up this new plant.

E-M Hi-Fuse Synchronous Motor Controls with Polarized Field Frequency Relays give Michigan Carton Company perfect motor synchronizing and provide complete protection to personnel through total enclosure and segregation of high-voltage and low-voltage circuits. And Michigan Carton gets complete short-circuit and motor protection, too.

E-M Hi-Fuse Controls are available with current limiting type high interrupting capacity power fuses that shut off short circuit current in a fraction of a cycle and provide a means for disconnecting each motor from the line.

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Make an appraisal now of *your* older, high-voltage motor controls. Do they provide the safety you should have for men and motors? Investigate modern E-M Hi-Fuse Motor Controls for your synchronous and induction motors on systems which require interrupting capacities up to 150,000 kva at 2300 volts and 250,000 kva at 4160 volts. Call in your nearby field engineer for an honest, impartial appraisal. Or write the factory today for Bulletin 192.

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2. Motor isolating disconnects—fuses that can be swung open.
3. Polarized Field Frequency Relay (Synchronous motor controls only)—for perfect synchronizing.
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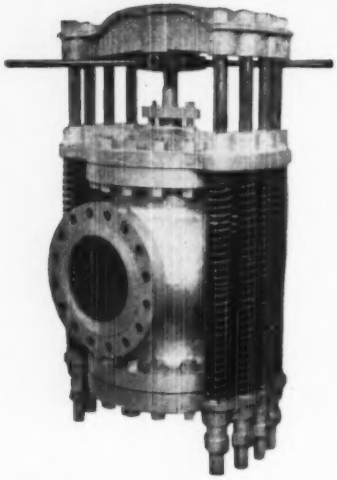
COMPLETE PROTECTION FOR MEN AND MOTORS

A Valve That Will Interest Every Power Engineer

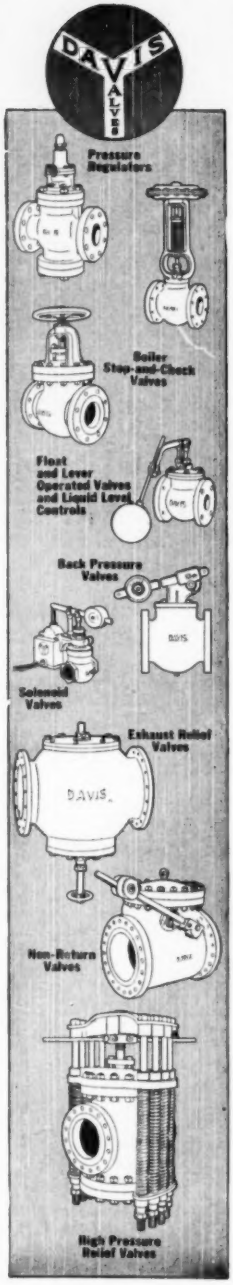


THE DAVIS No. 265 HIGH PRESSURE RELIEF VALVE

USES.—(1) For turbine relief on bleeder system. (2) For protection of any boiler room or process equipment by relief to atmosphere. (3) For relief of high pressure lines to low pressure lines at predetermined pressure. (4) For use in plants carrying multiple boiler pressures to protect lower pressure systems.

ADVANTAGES.—Multiple springs result in less spring accumulation . . . less build-up for maximum relief . . . less blowdown to close. Compact design with springs at sides reduces headroom requirements. Center adjusting screw available for quick, easy change of pressure setting.

BUILT TO REQUIREMENTS.—Offered in sizes from 4" to 30" in semi-steel or steel with bronze or stainless steel trim. Test lever and hold-open device available when desired. Detailed information on request.



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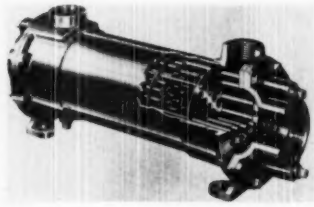
2540 S. WASHTENAW AVE., CHICAGO 8, ILL.

rod travels through bronze guide bearings in a vertical plane with the plunger.

Guide bearings are supported from the eccentric shaft-bearing stanchions bolted to the pump's base. These bearings prevent misalignment of the plungers or tendency toward eccentric motion in their vertical path. This reduces wear on the packing glands, plungers and cylinders. Lubrication is improved by a sight-feed-oiler system.

Ralph B Carter Co, Hackensack, N. J.



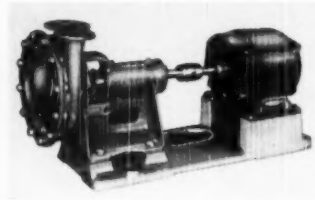
STANDARDIZED HEAT EXCHANGER, P 119, made of stainless steel, is offered in a complete range of sizes tested to 450 psi under the name of *Type SSCF*. **Ross Heater & Mfg Co, 1407 West Ave, Buffalo 13, N. Y.**

PRESSURE SWITCH **P159**

Weighing but 22 oz, this switch takes 1500 psi surge without requiring a calibration change. Operating range is adjustable from 10 to 500 psi.

Switch has a current rating of 10 amp at 110 v and 5 amp at 220 v. On a dc circuit it will handle ¼ to 6 amp inductive at 28 v. Contacts are spdt.

Cook Electric Co, 2700 North Southport Ave, Chicago 14, Ill.



CENTRIFUGAL PUMPS **P148**

Stainless-steel centrifugal pumps for process industries to handle acid and alkaline liquids for which standard iron and bronze pumps are not suited, because of corrosive and abrasive qualities of the fluids pumped.

Both suction and discharge connections are in the casing. Removal of casing cover permits inspection of pump's interior without disturbing pipe connections. Similarly, impeller may be removed or replaced without disturbing the pipe. Pumps built in eight sizes, 1-in. discharge by 1½-in. suction to 3-in. discharge by 4-in. suction. Capacities range up to 750 gpm, and heads up to 180 ft.

Impeller semi-open design, statically and dynamically balanced. Keyed to shaft and

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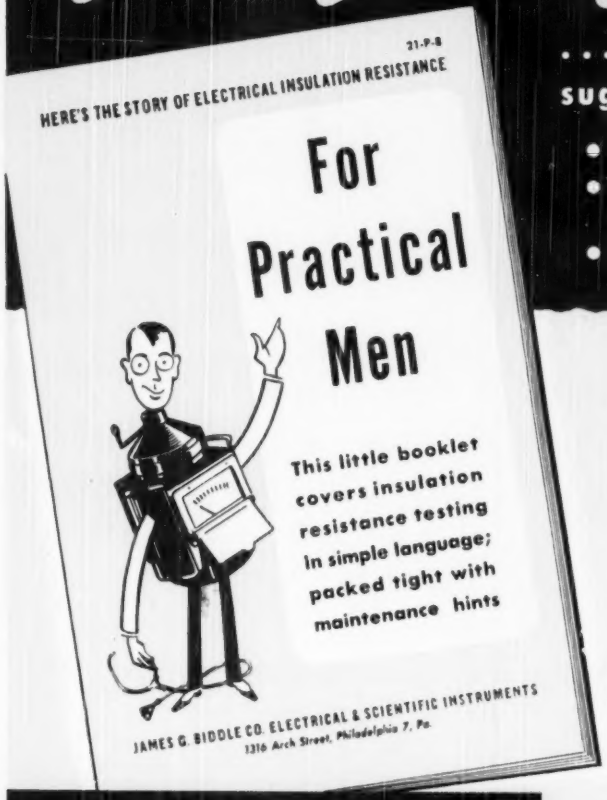
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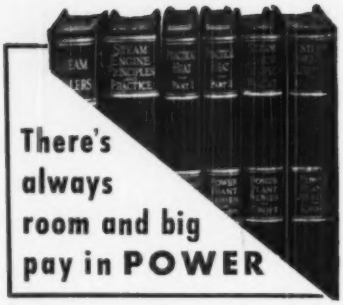

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This offer applies to U. S. only

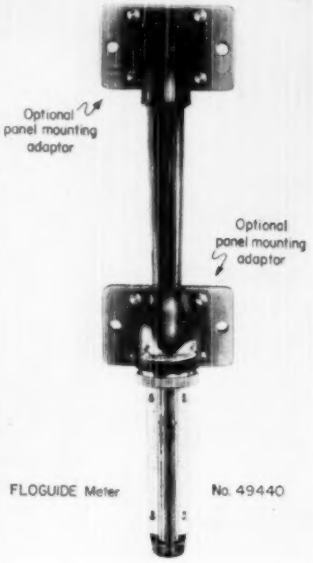
held in place by impeller nut. Impeller has tapped holes for easy removal. Provisions are made in the design so clearance can be adjusted between impeller vanes and casing to compensate for wear. **Goulds Pumps, Inc, Seneca Falls, N. Y.**

OIL CUP AND GAGE P168

Combination oil cup and oil gage serves a dual purpose. It can be used as a visible oil cup to replenish oil in bearings, transmission and crankshaft cases, etc, and al o as an oil gage for checking oil levels.

It can be installed at any convenient distance from the machine—on the outside of housing, on the other side of the wall. Shatter-proof plastic bottle keeps oil supply always visible.

Trico Fuse Mfg Co, 2948 No. 5th St, Milwaukee 12, Wis.



GAS FLOWMETER P140

Floguide has a tapered precision-bore metering tube and float of stainless steel. Available in capacities from 45 to 16,000 standard cubic feet of carbon dioxide per hour with comparable capacities for other gases.

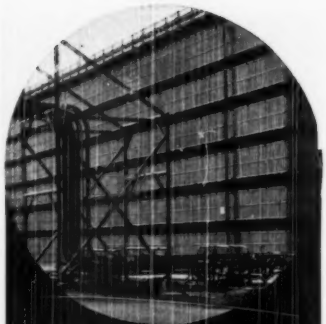
An extension below the metering tube carries the metering scale, and an indicator below the float permits direct reading of flow rate. Scale is rotatable for complete flexibility of installation. Although primarily designed for low pressure service, *Floguide* can be furnished to withstand 600 psig in all sizes.

Fischer & Porter Co, County Line Road, Hatboro, Pa.

INTAKE SCREEN P137

Thru-Clean screen removes trash and large solids from water intake.

Primary elements consist of a permanently supported rack of vertical steel bars and a power-operated cleaning mechanism



Monsanto SANTOBRITE controls slime and algae in cooling towers

Slime and algae, enemies of good cooling tower operation, are kept under control by Santobrite (Monsanto's sodium pentachlorophenate, technical). Santobrite is economical...easy to use...efficient.

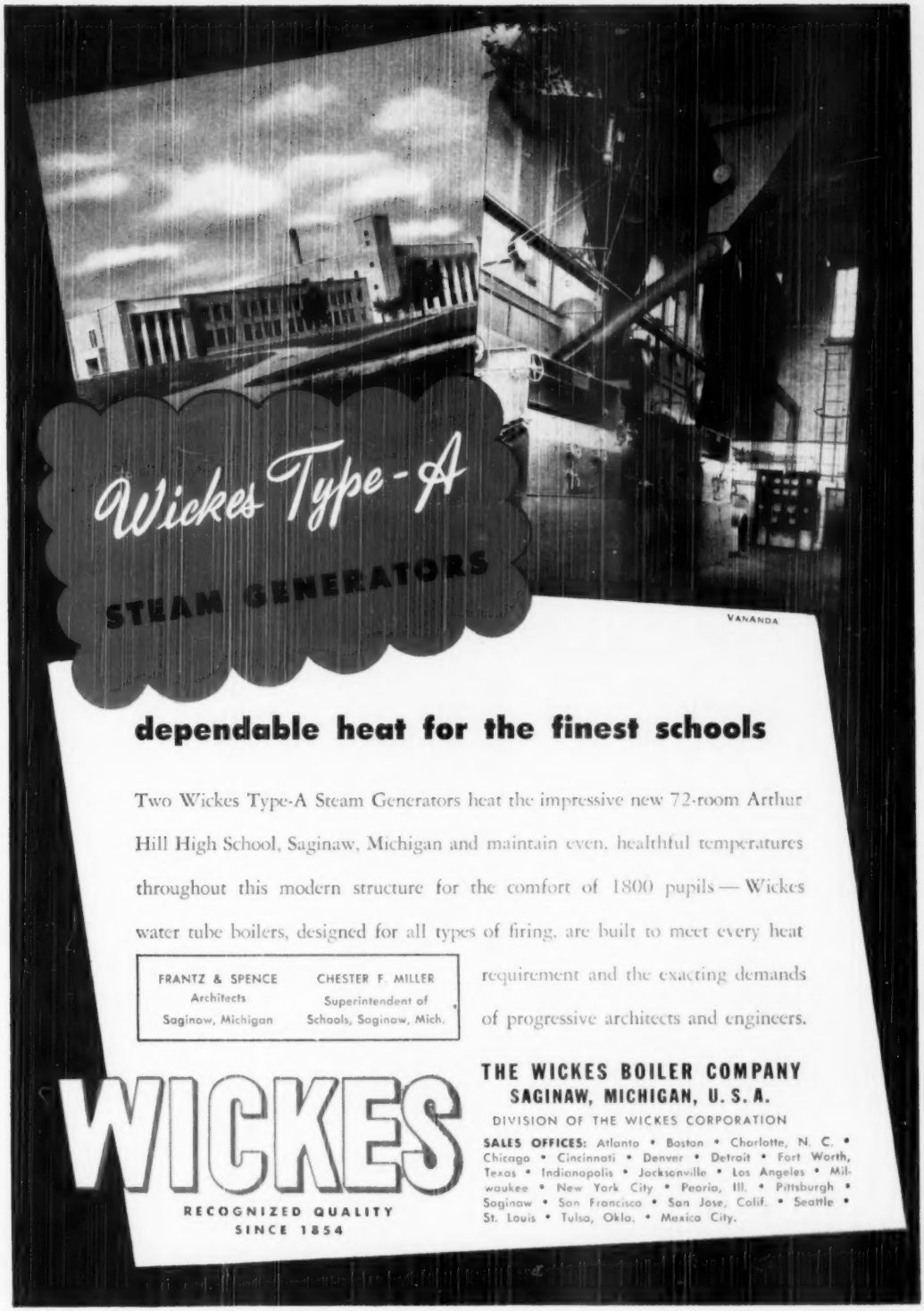
If slime and algae cause trouble in your cooling towers, it will pay you to read Monsanto Technical Bulletin No. O-15. For your copy, contact the nearest Monsanto Sales Office or write: MONSANTO CHEMICAL COMPANY, Desk A, 1763 South Second Street, St. Louis 4, Missouri.

Santobrite; Reg. U. S. Pat. Off.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

MONSANTO
CHEMICALS AND PLASTICS

SERVING INDUSTRY... WHICH SERVES MANKIND



dependable heat for the finest schools

Two Wickes Type-A Steam Generators heat the impressive new 72-room Arthur Hill High School, Saginaw, Michigan and maintain even, healthful temperatures throughout this modern structure for the comfort of 1800 pupils — Wickes water tube boilers, designed for all types of firing, are built to meet every heat requirement and the exacting demands of progressive architects and engineers.

FRANTZ & SPENCE	CHESTER F. MILLER
Architects	Superintendent of
Saginaw, Michigan	Schools, Saginaw, Mich.

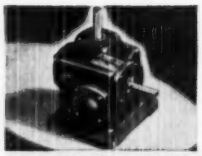
WICKES

RECOGNIZED QUALITY
SINCE 1854

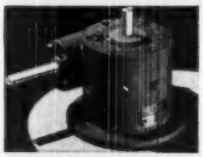
THE WICKES BOILER COMPANY
SAGINAW, MICHIGAN, U. S. A.
DIVISION OF THE WICKES CORPORATION

SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cincinnati • Denver • Detroit • Fort Worth, Texas • Indianapolis • Jacksonville • Los Angeles • Milwaukee • New York City • Peoria, Ill. • Pittsburgh • Saginaw • San Francisco • San Jose, Calif. • Seattle • St. Louis • Tulsa, Okla. • Mexico City.

Grooming the Horses TO RIDE IN THE MONEY



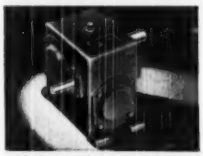
DBRA Series 1/20 to 1/8 H.P.



BV Series 1/5 to 12-1/2 H.P.

BT Series 1/5 to 12-1/2 H.P.

B Series 1/5 to 12-1/2 H.P.



DB Series 1/30 to 4-1/2 H.P.

You needn't be concerned with horses, real or mechanical, to profit from the experience of a roving amusement ride operator in Michigan.

He liked to give the youngsters a real whirl for their money. But he couldn't make money when the spinning horse carts broke down or when the kids were so jolted by abrupt starts that they were afraid to ride. Operating difficulties were spoiling the fun — and the profits.

At wit's end, the troubled operator called in Winsmith. It turned out to be true that a stock Winsmith reducer fit the job as a nut fits a bolt. But what really brightened the profit picture were the transmission improvements recommended by the Winsmith factory trained engineer who called. Effected at a negligible cost, they accomplished smooth, low-torque starting, permitted discarding of unpopular safety belts and eliminated shaft breakages. No more profit losses — the mechanical steeds now ride in the money.

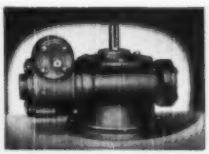
Your applications of power transmission may be remote from the amusement field. They may call for large, heavy duty speed reducers to operate sewage sludge agitators, or for fist-size units to rotate a glittering array of appliances on a display table.

Whatever the use, it's worth remembering that with Winsmith you get *widest* selection of stock reducers anywhere — and at the *lowest* cost. But what the ride operator remembers most about Winsmith is what will impress *you* the most from your very first contact . . . unique individualized service by factory trained transmission engineers.

CATALOG HANDBOOK No. 148

If you have it, get your name on the mailing list for new 1950 edition by writing today.

Ptd. Differential 1/10 to 81-1/2 H.P.



BDV Series 1/100 to 4-1/2 H.P.

BX Series 7/8 to 8-1/2 H.P.

WHS WINSMITH SPEED REDUCERS

WINFIELD H. SMITH CORPORATION

AGMA

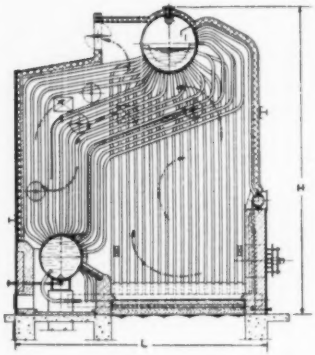
1000 OUT CATALOG 121

128 EATON ST., SPRINGVILLE, ERIE COUNTY, NEW YORK

employing two endless parallel strands of chain, which carry the cleaning rakes. Screenings are discharged on the upstream side to a belt conveyor or into a trough. Machine is protected against jamming by a conventional breaking pin or a *Link-Belt Electrofluid* drive. Ask for Folder No. 2327. **Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.**

SMOKE INDICATOR **P116**

Photoelectric, heavy-duty *McNeil* smoke indicator employs a density meter along with an alarm system for alerting personnel when a boiler smokes. Unit is ready for use on receipt. All that is needed is a relatively simple external wiring circuit. **Trimount Instrument Co, 37 W Van Buren St, Chicago 5, Ill.**



STANDARD BOILERS **P120**

New line, *Type C, of* 2-drum water-tube boilers ranging from 10,000- to 45,000-lb-per-hr steaming capacity are now available.

New boilers feature a bent-tube design that is compact and symmetrical. Gas enters the tube bank across the full width of the furnace. Superheater, air heater, and economizer can be furnished if desired. Firing equipment, such as oil, coal or gas, may be supplied.

Springfield Boiler Co, 1901 East Capitol Ave, Springfield, Ill.

FLARING TOOL **P133**

Rol-Air flaring tool #355-*F* can be used on copper, brass, and aluminum tubing for making flared tube joints. Ask for Bulletin No. 378.

Tool has three rollers embodied in the spreader cone, which roll the tubing end above the face of the flaring block. Original tube-wall thickness maintained throughout. Tool flares ¼, 5/16, ⅜, ½, ⅝ OD tubing. **The Imperial Brass Mfg Co, 1200 W Harrison St, Chicago 7, Illinois**

ROTARY PUMP **P150**

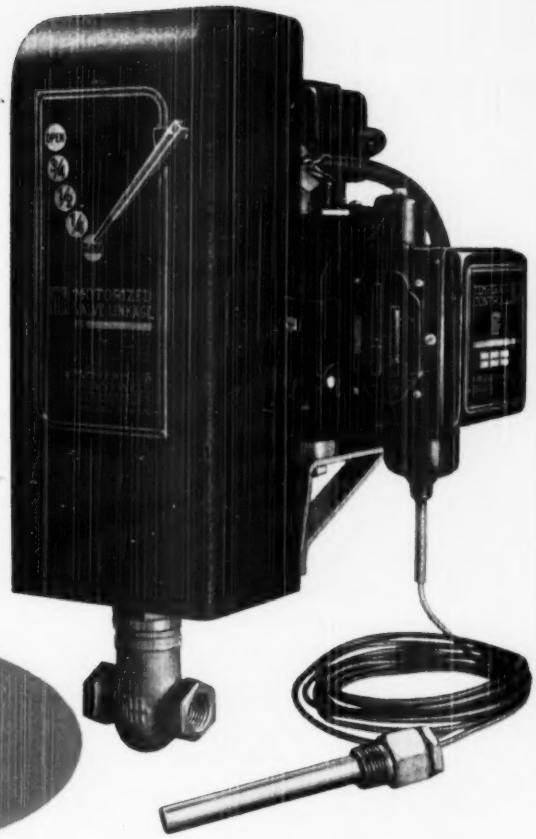
Positive displacement floating-vane design has yoke crosshead and off-center pin. Radial and lateral control floats the vane ends in the working chambers, preventing them from touching either the sides or races as they revolve.

Pin *P* fixed in pump head positions the

VERSATILE

ECONOMICAL

EASY TO INSTALL



THE NEW HONEYWELL SELF-CONTAINED TEMPERATURE CONTROLLER

IT MEASURES temperature by means of a remote bulb thermal system, and electrically operates its motor-driven control valve to maintain the desired temperature in hundreds of different operations and processes.

It provides the advantages inherent in a self-contained unit . . . ease of installation and economy of operation . . . plus the power and positive action of an electrical system. And it costs as little as $100.

Check with your local Honeywell engineer for detailed information . . . or write for a copy of descriptive Bulletin 80-1.

BROWN INSTRUMENTS — WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

CHECK THESE FEATURES:

- √ *Temperature range from 0 to 700° F.*
- √ *External control point setting . . . graduated in degrees F. and C.*
- √ *Available with electric proportional or two-position control.*
- √ *Electric proportional style includes V-port valve . . . providing true proportional control.*
- √ *Positive valve positioning.*
- √ *Oil-immersed control motor.*
- √ *Selection of valve sizes . . . ¼" to 6".*

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BROWN INSTRUMENTS DIVISION
4490 Wayne Ave., Philadelphia 44, Pa.
Offices in 73 principal cities of the United States, Canada and throughout the world

Honeywell — *Advanced Instrumentation* — BROWN

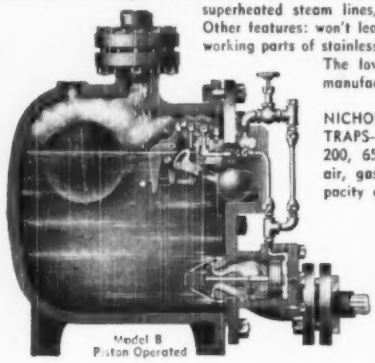
FOR BETTER PROCESSING

Enormous Drainage Capacity of Nicholson

PISTON - OPERATED SUPER - TRAP

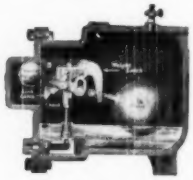
Adapts It Especially to Power Plant Use

With valve orifices up to 2" diam., Nicholson piston-operated steam traps offer unsurpassed drainage capacity. Universally specified for draining steam purifiers in power plants, where thousands are in use; discharge large volumes of water almost instantly. Increasingly installed wherever water and dirt in volume are a problem: superheated steam lines, headers, separators, heaters. Other features: won't leak even if cooked dry; rugged; working parts of stainless steel. Pressures, 2 to 650 lbs. The lowest price large-capacity trap manufactured.



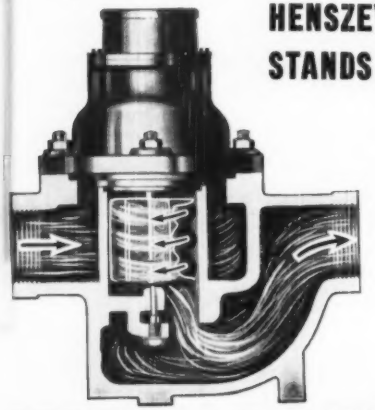
Model B Piston Operated

NICHOLSON WEIGHT - OPERATED TRAPS—Three models for press. to 200, 650 and 1500 lbs.; for steam, air, gasoline. Also feature large capacity and proof against leaking.



Catalog 448 or see Sweet's

W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.



HENSZEY *Feed Water* METER STANDS UP *where others* FAIL

The cutting, abrasive action of hot, dirty Boiler Blowdown quickly breaks down meters that depend upon close clearances and intricate parts for their accuracy. Henszey Meters stay accurate—stay on the job—accurately measuring Boiler Blowdown, Feed Water, Condensate, Free-Running Chemicals and other "hard-to-measure" liquids. Send for details.

HENSZEY CO., Dept. D1, WATERTOWN, WISCONSIN

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Boiler Feed Regulators • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

vanes on the square block *B*. Ends of the vanes in grooves cut in the rim in rotor *R*. As the rotor turns the vanes move back forward on the square block so they are always correctly positioned in the pump's casing. Capacities are 10 to 20 gpm at pressures of 50 to 70 psi.

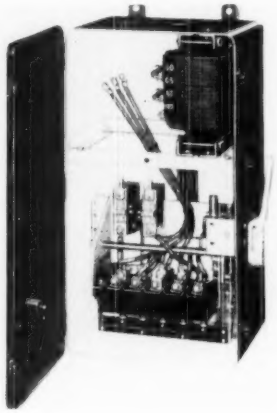
Chicago Laboratory & Engineering Co. 4140 N Kedzie Ave, Chicago 18, Ill.

AUTOMATIC OILER P122

Metering type, visible oil container *No. 3000* has a needle valve for adjusting air-oil flow for top cylinder lubrication of gasoline and gas engines.

There are no moving parts to wear out. The vacuum created in the engine draws the air-oil mixture into the carburetor through the intake manifold. Top oiler is screwed or bolted to the bulk head and its outlet tube connected to the carburetor through the gasket in the intake manifold.

Universal Lubricating Systems, Inc. 791 Allegheny Ave, Oakmont, Pa.



MOTOR-STARTER P153

Manual, autotrans-former-type starter for squirrel-cage motors. It is available in four sizes from 5 hp, 220-440-550 v, to 250 hp, 440-550 v; for 25, 50 and 60 cycles.

Switch mechanism operates with a quick-make quick-break action. Two automatic reset overload relays are standard equipment in all starters. A time-delay under-voltage release, preventing unnecessary opening of the switching mechanism on slight voltage dips, is standard on the largest starter.

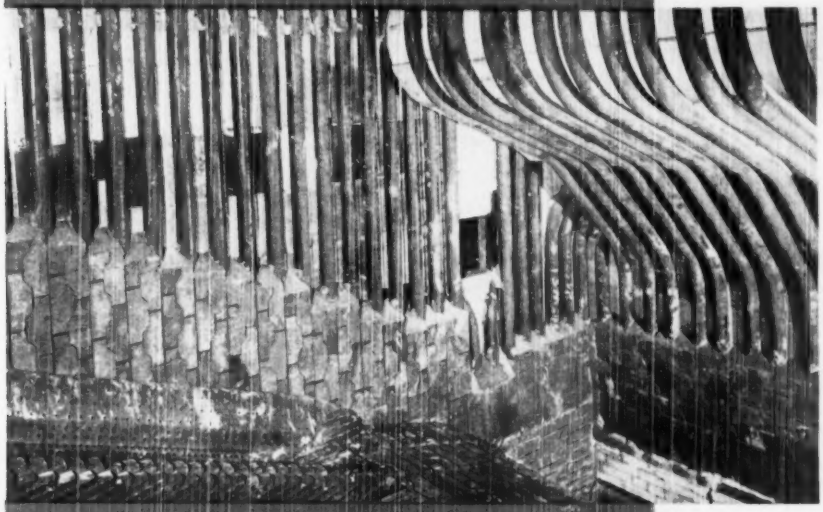
Allen-Bradley Co, Milwaukee, Wis.

TOTALLY ENCLOSED MOTOR P164

Identified as Type TEFC, polyphase, 50 or 60 cycle, constant-speed, continuous-duty, squirrel-cage induction with high torque and low starting current. Power sizes 2 to 60 hp.

Motor housing is totally enclosed. Air is drawn in through the external hood. It then passes over the stator core and out over the pulley bearing. Actual temperature rise on the stator windings will not ex-

BERNITZ-NYGAARD WATER WALL BLOCKS



NO FURNACE CONDITIONS TOO SEVERE!

WHERE OTHER TYPES FAIL

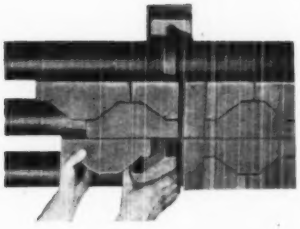
BERNITZ-NYGAARD BLOCKS

OF "CARBOFRAX" SUCCEED . . .

* Carbofrax" is the registered trade mark of, and indicates manufactured by, the Carborundum Co.

Outstanding Features:

- Exceptionally long life.
- Erection cost negligible.
- Simplicity of construction makes special supervision of erection usually unnecessary.
- Blocks erected from the fire side of the tubes without disturbing construction at the rear.
- No bolts or clamps to strain the Blocks.
- Each block free to expand and independently follow the movement of the tube during operation.
- Large contact area and neat fit to the tubes for rapid heat transfer and cooling of blocks.
- Permits operation at higher temperatures and higher heat release, speeding up combustion and reducing carbon losses.
- Reserve heat stored up in the Carbofrax blocks promotes re-radiation back to the furnace with reliable ignition and improved combustion as a result.
- Blocks manufactured to fit all standard size boiler tubes both straight and curved to standard radius bends.



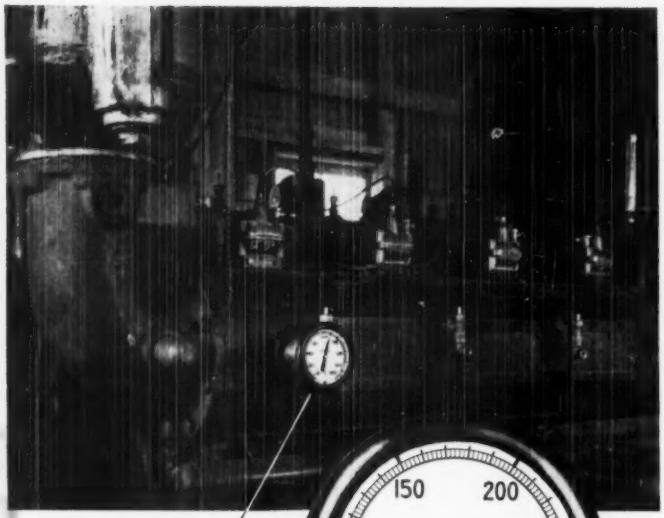
Insert shows simplicity of erection

OTHER PRODUCTS INCLUDE:

Bernitz furnace linings • Super blocks • Blocks for walls and arches • Bernitz air-cooled floors • Bernitz super-generator linings for water gas sets • Bernitz air-cooled spreader, stoker piers • Oil burner rings

BERNITZ
NYGAARD WATER WALL BLOCKS

BERNITZ FURNACE APPLIANCE CO.
89 BROAD STREET, BOSTON 10, MASS.
NEW YORK — PHILADELPHIA — SYRACUSE — ATLANTA — PITTSBURGH — CLEVELAND — CINCINNATI — DETROIT — CHICAGO — INDIANAPOLIS — MINNEAPOLIS — KANSAS CITY — RENO
MONTREAL — TORONTO — WINNIPEG



WHERE RUGGEDNESS RATES!

it's WESTON

All-Metal Thermometers

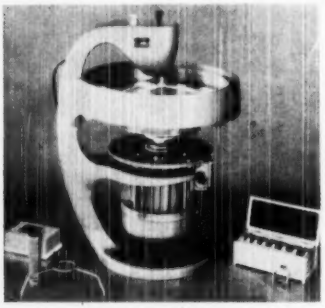
Where the going is tough, WESTON thermometers get first call. Their rugged construction—all-metal throughout—enables them to stand up on pumps, compressors and mobile units. And the big, bold dials are easy to read—quickly and accurately! There are many types, stem lengths and scale ranges from which to choose. Ask your jobber or local WESTON representative, or write for Thermometer Bulletin. WESTON Electrical Instrument Corporation, 679 Frelinghuysen Avenue, Newark 5, New Jersey.

CONTACT-MAKING models for alarm or control purposes. MAX-MIN models to indicate highest or lowest temperature reached.

WESTON Instruments

reed 55 C. Ball-bearing temperature rise in the motor is 30 C or less.

Valley Electric Corp, Dept 128, 4221 Forest Park Blvd, St. Louis 8, Mo.



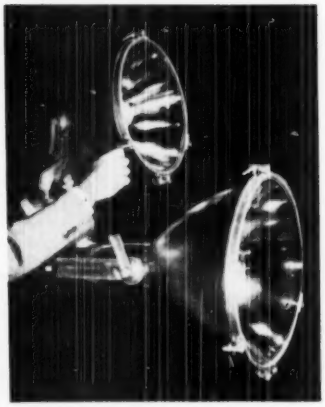
DUST CLASSIFIER **P106**

A new laboratory apparatus, above, the *Centrifugal Dust Classifier*, grades dust particles from typical flue-dust samples, and gives a good division of those particles below 60 microns.

A rotary symmetrical slot acts as the entrance port for the entering dust-laden air stream. The slot shapes the stream to a spiral directed toward its center. The whole sifting chamber rotates so the material to be sized receives a gentle treatment. One part of the dust sticks to the outer wall of the classifier under the influence of centrifugal force. The lighter elements carry along with the air current toward the center. The fraction sifted collects on the stop flange of the rotor.

The apparatus is empirically calculated and grain size limits are easily altered. Result of the analysis is gained as a graph, with the whole operation taking only 2 hr.

Sandvick Saw & Tool Corp, 47 Warren St, New York 7, N. Y.



FLOODLIGHTS **P166**

Type L-84 rated at 500 watts and the Type L-85 rated 1000 watts can be used for all general-purpose applications. They are available for either general lighting service or floodlighting service lamps.

Weather-tight and constructed of heavy-

OIC UNION BONNET BRONZE GATE VALVE

GIVES YOU MONEY-SAVING FEATURES YOU'LL WELCOME

This series of OIC valves (Figure nos. 7200, 7202 and 7208) is rated for working pressures of 200 pounds steam at 550°F. — 400 pounds water, oil and gas, non-shock. Union bonnet screwed-end type. Solid wedge rising stem, double-disc rising stem and solid wedge non-rising stem designs. Tapered seats and wedges of OIC copper nickel alloy. You'll find this new valve a money-saver on water, oil, gas, steam or any other service where bronze gate valves are used.

LONGER LIFE—LOWER COST

Scientifically designed, constructed of highest quality materials, accurately machined and thoroughly tested for trouble-free operation.

EASILY SERVICED—LOWER MAINTENANCE

Easy to dismantle and reassemble. Quick inspection and servicing. Easy repacking.

EASIER OPERATION—SAVES TIME

Perfect seating without binding or undue wear. Straight-through flow. Minimum pressure drop.

STRONGER—GREATER SAFETY

Ample wall thicknesses. No dangerous stress concentrations. Leak-proof joints.

OIC
PACE SETTER IN VALVES

SPECIAL INTRODUCTORY OFFER

If you'd like to check this OIC bronze 200 lb. union bonnet gate valve, simply send us the size and we'll deliver you a sample on memo billing. Inspect it, analyze it, take it apart, test it. At the end of 30 days, if you're not convinced of its superiority over any comparable valve you've ever used, return it for full credit.

THE OHIO INJECTOR CO.
221 MAIN ST. WADSWORTH, OHIO

BRONZE • IRON • CAST STEEL • FORGED STEEL

SALES and SERVICE

SERVICE FOR EVERY PORT

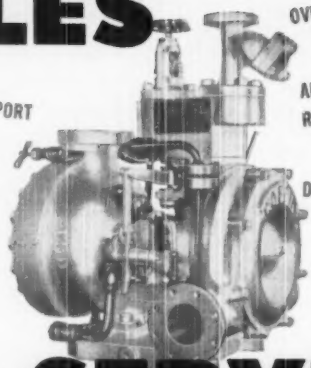
OVERNIGHT SERVICE

ALL WEARING PARTS REPLACEABLE

DEPENDABLE SERVICE

SIMPLIFIED MAINTENANCE

SPECIALIZED MARINE ENGINEERING AVAILABLE



COFFIN

TURBO BOILER FEED PUMPS

KNOWN FOR DEPENDABILITY and PERFORMANCE

Coffin Turbo Pumps have been specified and used by leading naval architects, engineers, and ship operators for years because they're dependable, compact and *precisely engineered to the job*. Standardized boiler feed units are available in various combinations with the following ratings:

STEAM PRESSURES TO 850 PSI
BACK PRESSURES TO 200 PSI
PUMP CAPACITIES TO 500 GPM
DISCHARGE PRESSURES TO 1100 PSI
(Heads to 2500 Feet)
LIQUID TEMPERATURES TO 300°F

Extremely compact, light in weight, and quiet-operating, Coffin Pumps afford minimum steam consumption through high, built-in pump efficiency plus two-bucket row turbine design.

SPECIALIZED MARINE ENGINEERING SERVICE AVAILABLE

Coffin Pumps are sold and serviced by marine specialists strategically located in order to give fast, dependable help on all possible applications of Coffin Pumps. Special "packaged" service and parts depots make faster "turn-arounds" possible and eliminate unnecessary tie-ups while in port.

Write for Bulletin "S"

L. O. ARRINGDALE, GENERAL AGENT
MARINE DIVISION
17 BATTERY PLACE, NEW YORK, NEW YORK

Marine Specialty Co.
6-12 So. Water Street
Mobile, Ala.

Cordes Bros.
34 Davis Street
San Francisco, Calif.

John H. Marvin Co.
1016 First Avenue, South
Seattle, Washington

INDUSTRIAL · RAILROAD · COFFIN · MARINE · PRODUCTS

P. Thompson Tool & Supply Co.
1104 Tchoupitoulas Street
New Orleans, La.

John H. Marvin Co.
Portland
Oregon

J. M. Castello Supply Co.
221 No. Avalon Blvd.
Wilmington, California

MAIN OFFICE & PLANT
THE J. S. COFFIN, JR., COMPANY
326 SOUTH DEAN STREET, ENGLEWOOD, NEW JERSEY

gage aluminum, each of the new units weighs less than 17 lb. Non-corrosive materials—aluminum and stainless steel—are used throughout. The door, hinged for easy relamping, uses three simple swing-type door latches.
General Electric Co, Schenectady 5, N.Y.

PROCESS HEAT **P111**

Self-contained, direct-fired industrial heating unit, *Thermobloc*, is available in a new design for drying lacquers, finishes or any material needing temperatures up to 500 F.

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Prat-Daniel Corp, East Port Chester, Conn.

SELF-STICKING PIPE MARKER, P 132, *Quik-Label* is suitable for small pipe and conduit from ¼- to 2-in. sizes.
W H Brady Co, 815 North Third St, Dept 120, Milwaukee, Wis.

DUAL-BULB THERMOSTAT, P 104, controls supply-water temperature in a hot-water heating system according to the action of separate outdoor- and indoor-mounted bulbs.
Barber Colman Co, Rockford, Ill.

PLANT EQUIPMENT NEWS

Reader Service Page for New Products and Literature

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATING

A12 **DIRECT-FIRED UNIT HEATER**—Thermobloc Div, Pratt-Daniel Corp, East Port Chester, Conn. Data file No. 901 contains complete descriptions of Thermobloc self-contained direct-fired industrial heating units of 300,000- and 550,000-Btu-per-hr output capacity. Data tables for computing heat loss and figuring heat requirement are given.

A13 **VANED DAMPER** — Anemostat Corp of America, 10 E 39th St, New York, N. Y. 4-page folder No. 36 describes construction, installation and operation of Turnotrol, a turning vane and volume-control device for balancing heating, ventilating and air-conditioning systems.

A14 **ALL-ELECTRIC UNIT HEATERS** — Electromode Corp, 45 Crouch St, Rochester 3, N. Y. 8-page catalog No. EC-43 gives complete specifications, prices, illustrations of units, and shows typical installations of Electromode heaters.

A15 **WARM-AIR HEATING** — Pratt-Daniel Corp, East Port Chester, Conn. Bulletin No. 19 SA-401 tells about the new Thermobloc self-contained, direct-fired industrial-heating unit that can perform the function of tempering makeup air whether it is used as a plant heating system or as an auxiliary unit.

A16 **AIR HEATERS**—Dravo Corp, Dravo Bldg, Pittsburgh 22, Pa. Brochure No. 510 describes Dravo Counterflow warm-air space heaters, and their application in foundries and other types of industries. Typical examples are illustrated.

BOILERS AND AUXILIARIES

B19 **CENTRIFUGAL BLOWERS AND EXHAUSTERS** — Roots-Connersville Blower Corp, 900 W Mount St, Connersville, Ind. 24-page booklet No. 138-B-14 discusses operating characteristics of R-C units. Design and construction features of single-stage and multi-stage units are given, as well as cross-sections, diagrams, curves, exploded views, etc.

B20 **BOILER TUBES** — Babcock & Wilcox Tube Co, Beaver Falls, Pa. Price sheets for minimum-wall, seamless, carbon-steel merchant boiler tubes are available. The list covers cold-drawn tubes in sizes 1-in. and 1¼-in. outside diameter, and hot-finished tubes in sizes 1½-in. through 6-in. outside diameter, in various wall thicknesses, with cut lengths 4 to 24 ft inclusive.

CONTROLS, ELECTRIC

D16 **TIME SWITCHES AND TIMERS** — Sangamo Electric Co, Springfield, Ill. 16-page catalog No. 1010M gives informative data on several types of Sangamo time switches and timers. Connection diagrams, installation instructions, and information for ordering are also included.

D17 **ELECTRONIC CONTROLS** — Photoswitch Inc, 77 Broadway, Cambridge 42, Mass. 66-page book, entitled "Cutting Production Costs with Electronic Controls," contains 45 case studies describing actual examples of cost-saving production techniques.

ELECTRICAL EQUIPMENT

F36 **SINGLE-PHASE CAPACITOR MOTOR**—General Electric Co, Apparatus Dept, Schenectady, N. Y. 12-page folder No. GEA-5401 features

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the new Tri-Clad single-phase capacitor motor. Dimensions, specifications, characteristics, construction features and illustrations are included.

F37 **LIGHTING EQUIPMENT GUIDE** — Benjamin Electric Mfg Co, Des Plaines, Ill. Bulletin, entitled "Planned Lighting Equipment Selection Guide," clarifies the application of twelve basic industrial lighting systems for general lighting.

F38 **LARGE AC GENERATORS** — Electric Machinery Mfg Co, Minneapolis 13, Minn. 8-page booklet No. 3300-PRD-196 tells in non-technical language the points to look for when ordering generators. Construction features and recent installations of large slow-speed engine-type generators are shown.

F39 **SINGLE-PHASE RECTIFIERS** —Accurate Engrg Co, 3006 Blue Island Ave, Chicago 8, Ill. 8-page folder No. 500 describes and illustrates in detail the Accurate line of single-phase tube-type power rectifiers in dc output capacities from 115 to 3680 watts, for industrial applications.

F40 **POWER CABLES** — General Electric Co, Construction Materials Dept, Bridgeport, Conn. 12-page publication No. 19-385 deals with the method of determining cables and cable sizes of asbestos-varnished cambric cables, Types AVA, AVB, and AVL. Step-by-step instruction is given on figuring load current, voltage drop, cables, and cable sizes for both lighting and motor loads.

F41 **WIRE CONNECTORS** — Ilsco Copper Tube & Products Inc, Cincinnati 27, Ohio. 68-page catalog No. 50 is replete with illustrations, dimension tables and price lists of the company's line of electrical connectors and accessories.

F42 **OIL CIRCUIT BREAKER** — Allis-Chalmers, Milwaukee 1, Wis. 8-page folder No. 71B6032C describes in detail Type BZO-160 oil circuit breakers for electrical protection of high-voltage transmission equipment. Construction details are shown.

F43 **ELECTRIC MOTORS**—Sterling Electric Motors Inc, Los Angeles 23, Calif. 4-page bulletin No. 161A gives informative data on Sterling Sto-Speed electric power drives. Gear-design chart and price sheets are included.

F44 **MOTOR CONSTRUCTION** — Allis-Chalmers, Milwaukee 1, Wis. 8-page catalog No. 51B-6310B tells the story of Allis-Chalmers' Safety-Circle motor protection. Design and construction features are illustrated.

MAINTENANCE AND SAFETY EQUIPMENT

K8 **RING PACKING**—Greene, Tweed & Co, North Wales, Pa. Single-sheet No. TBPR-619 gives data on Palmetto Pisto-Ring packing designed to replace hydraulic duck and other forms of packing used in inside-packed reciprocating pumps.

K9 **FIRE-EXTINGUISHING EQUIPMENT**—Ansul Chemical Co, Marinette, Wis. 20-page booklet No. F-4992 illustrates complete line of Ansul dry-chemical fire equipment. Included are improved Model B extinguishers, piped systems, large stationary units, fire trucks, trailers, etc, as well as charts showing characteristics of approved hand fire equipment.

K10 **PORTABLE POWER TOOLS**—Independent Pneumatic Tool Co, 175 State St, Aurora, Ill. Catalog No. E-2 covers Thor universal electric portable power-tool line including the Silver Line tools. Prices are given. Also, circular No. JE-1131 features the new Thor Silver Line 4½-in. universal electric belt sander.

K11 **PIPE LINE SHOCK ABSORBER** —R-S Products Corp, 4530 Germantown Ave, Philadelphia 44, Pa. Bulletin consists of description, applications, installation, and list prices of four models of a compact shock absorber, which eliminates shock and hammering in pipelines carrying water or petroleum products.

K12 **REFLECTOSCOPE** — Sperry Products Inc, Danbury, Conn. 4-page folder No. 50-105 discusses the principle and operation of Type UR reflectoscope, an ultrasonic instrument for instantaneously locating defects in metals and other materials by the application of a single "searching unit."

MAINTENANCE MATERIALS

L30 **LUBRICANT - APPLICATION GUIDE**—Keystone Lubricating Co, 21st and Lippincott St, Philadelphia 32, Pa. 30-page booklet No. C-19L presents the line of Keystone specialized lubricants for industrial and automotive machinery. Included in the guide are tested recommendations for lubricating all types of bearings under various operating conditions.

L31 **TURBINE LUBRICATION** — E F Houghton & Co, 303 W Lehigh Ave, Philadelphia 33, Pa. 4-page folder, entitled "Turbo-Drive," discusses problems of oxidation, emulsification, foaming and sludging, as related to turbine lubrication.

L32 **GAGE SNUBBER**—Parker Appliance Co, 17325 Euclid Ave, Cleveland 12, Ohio. Bulletin No. 380 explains action of the Parker pressure-gage snubber in protecting gages from line shocks and vibration while eliminating needle fluctuation for more accurate readings.

MATERIALS HANDLING

M22 **WIRE ROPE** — Macwhyte Co, Kenosha, Wis. 4-page leaflet No. 49-30 lists 133 different sizes and types of corrosion-resisting wire rope. Constructions of various types are described and illustrated.

M23 **CONVEYING SYSTEMS**—Fuller Co, Fuller Bldg, Catasauqua, Pa. 24-page booklet No. PK-25 presents informative data on Fuller-Kinyon conveying systems for unloading and conveying dry pulverized materials. Details of construction and operation, diagrams and typical installations are included.

M24 **GROOVED-WHEEL CASTERS** —Bassick Co, Bridgeport, Conn. 8-page folder furnishes latest information on Bassick "V" grooved-wheel casters for angle-iron track. Cross-sectional designs illustrate corner turns, turn-and-crossover and single- and double-switch installations of the track.

M25 **FORK TRUCK OPERATION** — Yale & Towne Mfg Co, Roosevelt & Haldeman Ave, Philadelphia 15, Pa. 4-page folder No. P1170 gives instructions on how to operate gas trucks safely and with minimum of wear to moving parts.

MECHANICAL TRANMISSION

N15 **FLUID DRIVES**—Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill. 24-page book No. 2385 replaces

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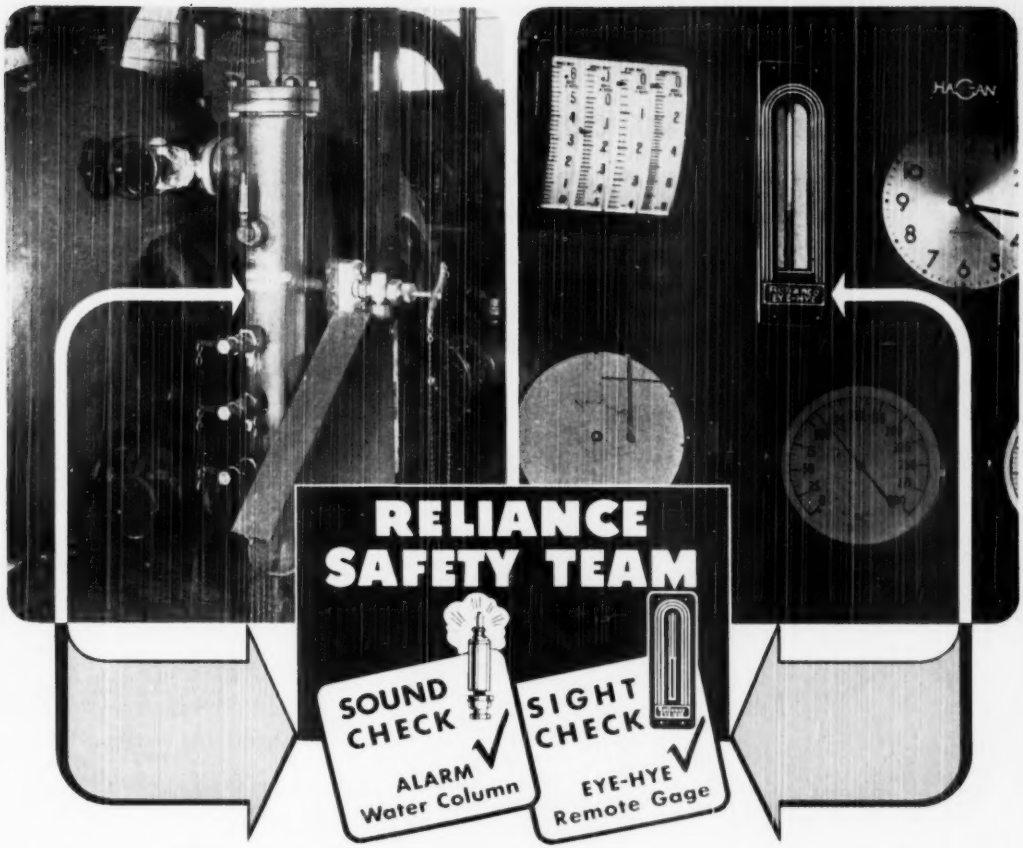

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previous catalog on Link-Belt fluid drives. Book covers types, sizes, arrangements and dimensions of units available; features of construction; advantages to user; selection tables; typical examples of fluid-drive selections; and numerous photographs of actual installations.

N16 **DISK CLUTCHES** — Edgemont Machine Co, Dayton, Ohio. 12-page bulletin No. SF-5 tells about Edgemont Type SF disk clutches. Application, price lists and data are included.

N17 **BALL BEARINGS** — New Departure Div, General Motors Corp, Bristol, Conn. 16-page booklet describes and illustrates five distinct types of New Departure self-sealed and lubricated-for-life, ball bearings designed for belt and trolley conveyors, foundry-mold car wheels and similar applications.

METALS AND ALLOYS

R10 **METAL DRAWING** — Esso Standard Oil Co, 15 W 51st St, New York 19, N. Y. 12-page folder, entitled "Drawing Compounds for Metals," contains detailed recommendations for selecting drawing compounds for use on various ferrous and non-ferrous metals in stamping, forming, wire drawing, tube drawing, tube bending, etc.

R11 **CALCIUM CARBIDE**—National Carbide Corp, 60 E 42nd St, New York 17, N. Y. 16-page leaflet, entitled "The Miracle of Calcium Carbide," traces the history of calcium carbide from the time of its discovery as a commercial possibility over 50 years ago, through the development of manufacture and the current and potential usage of commercial calcium carbide, acetylene gas, and calcium hydrate residue.

R12 **HARDENING COMPOUND** — Wilson Carbon Co, 60 E 42nd St, New York 17, N. Y. Bulletin No. 11 is a technical report on treating carbon steel with new activated carbon-chromium hardening compound, *High-Speed-It*.

METERS AND INSTRUMENTS, ELECTRIC

S4 **RECORDING OSCILLOGRAPHS**—Consolidated Engineering Corp, 620 N Lake Ave, Pasadena 4, Calif. 16-page publication, entitled "Consolidated Recording Oscillographs," discusses applications, operations, and features of multichannel recording oscillographs.

S5 **WATTHOUR METER** — Roller-Smith, Bethlehem, Pa. 12-page catalog No. 4425 illustrates and explains the different parts assembled into the Type S-3 watthour meter. Operating characteristics are included.

METERS AND INSTRUMENTS, MECHANICAL

T23 **PYROMETER INDICATORS** — Thermo Electric Co, Inc, Fair Lawn, N. J. 4-page folder No. 25 describes the company's multiple-point pyrometer indicators. Dimensional drawings and prices are given.

T24 **SURFACE PYROMETERS** — Pyrometer Instrument Co Inc, Bergenfield, N. J. Catalog No. 180 presents informative data on the new Pyro surface pyrometer, a completely self-contained, portable, compact and quick-acting instrument.

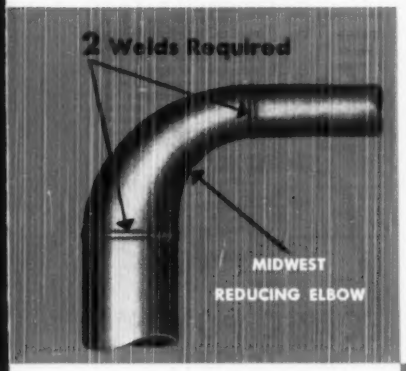
PIPING, FITTINGS, VALVES AND SPECIALTIES

U31 **GATE VALVES**—Crane Co, 836 S Michigan Ave, Chicago 5, Ill. 4-page folder explains the new Crane fluid-motor-operated gate valves. Cross-section views are shown.

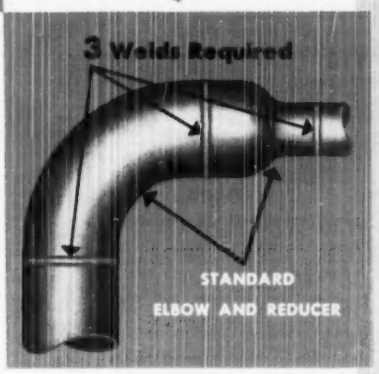
U32 **PIPELINE STRAINERS** — Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa. 4-page bulletin No. S-202 is a revised publication on Yarway strainers. Pressure and screen data tables are given.

U33 **HYDRAULIC SURFACE VALVES**—R-S Products Corp, Wayne Junction, Philadelphia 44, Pa. 12-page booklet No. 18 introduces a new

SAVE MONEY and get BETTER PIPING by using the MIDWEST REDUCING ELBOW



Instead of a Standard Elbow and a Reducer



The Midwest Reducing Elbow saves more than a third of the welding when used instead of a standard elbow and reducer. In addition to a substantial saving in time and money, it provides much neater appearance and insulation is easier. The gradual reduction, smooth curve and absence of abrupt neck reduce the pressure drop and turbulence. Center-to-end dimensions are the same as for ASA standard elbows.

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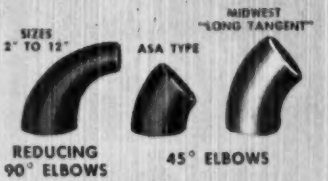

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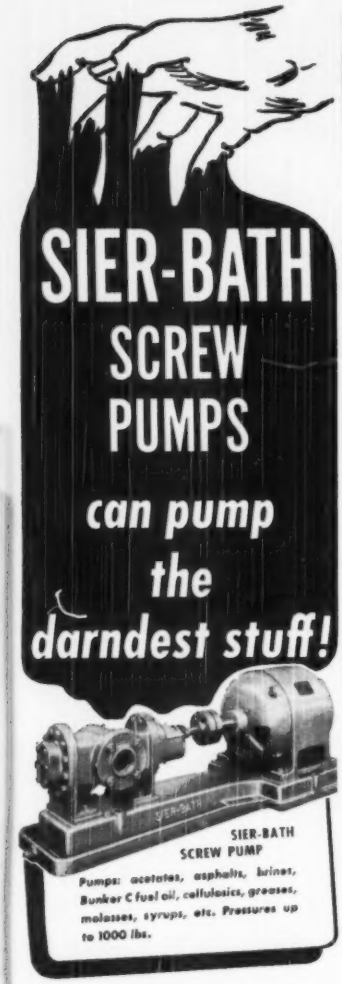

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U34 **INSTRUMENT VALVES** — Edward Valves, Inc, East Chicago, Ind. 4-page leaflet No. 491 contains dimensions, weights, prices and operating data on new drop-forged-steel Edward instrument valves for meter, gage, instrument and other small lines.

U35 **GATE VALVES** — Kennedy Valve Mfg Co, Elmira, N. Y. Circular No. 120 gives an informative description of the Figure 27 and Figure 30 line of standard bronze gate valves. Design features are explained in detail with a large sectional drawing of a valve providing easy visual reference.

U36 **VENTURI-BALL VALVES** — Paul Valve Corp, 683 Third Ave, New York 17, N. Y. 16-page catalog No. 103 covers principles of operation and engineering data on the complete line of Paul high-performance venturi-ball valves, including "whistle," bar-stock, cast-steel, stainless-steel, and forged valves.

U37 **STOP-CHECK VALVES**—Crane Co, 836 S Michigan Ave, Chicago 5, Ill. 4-page folder tells about Crane automatic stop-check valves in sizes and types for all boiler pressures. List prices are given.

PRIME MOVERS AND ACCESSORIES

V8 **DIESEL ENGINE**—Nordberg Mfg Co, 3073 S Chase Ave, Milwaukee 7, Wis. Series of four bulletins No. 166, 167, 167-A and 168 describe the new Nordberg Model 4FS-1 diesel engine, a one-cylinder, 4½x5½-in. unit rated at 15 hp at 1800 rpm, and 10 hp at 1200 rpm.

V9 **INDUSTRIAL DIESELS** — Cummins Engine Co, Inc, Columbus, Ind. Two booklets No. 5287 and No. 5289 contain complete specifications of all automotive and industrial models of HT-600 and HRS-600 Cummins four-cycle, six-cylinder diesels.

V10 **RADIAL ENGINE** — Nordberg Mfg Co, 3073 S Chase Ave, Milwaukee 7, Wis. 8-page folder No. 172 features the new Nordberg two-cycle, 11-cylinder, 14x16-in, radial engine, which develops 1800 hp at 400 rpm, or 1250 kw. A cross-section view of the entire engine and of the pressure system of lubrication and piston cooling is also shown.

PUMPS

W20 **CENTRIFUGAL PUMPS** — Durlron Co Inc, Dayton 1, Ohio. 12-page bulletin No. 812A discusses installation and operation of centrifugal pumps in corrosive service. Friction data, formulas for figuring capacity, head and horsepower, and conversion data are included.

W21 **TWO-STAGE PUMP** — Warren Steam Pump Co Inc, Warren, Mass. 4-page brochure No. 246 explains the new Warren 2-stage pump, Type TL, available in various sizes. Data consist of specifications, dimensions and a sectional view of this pump.

WATER TREATMENT

X8 **DEAERATING HEATERS**—Graver Water Conditioning Co, 216 W 14th St, New York 11, N. Y. Bulletin No. W101 outlines principles of deaeration, and describes the design, operation and applications of Graver deaerating heaters. Both vertical and horizontal types are diagrammed.

X9 **HARDNESS TEST**—W H & L D Betz, Philadelphia 24, Pa. 8 sheets of technical data describing a new, simple hardness test for water analysis that is more accurate and faster than the soap method.

X10 **WATER SOFTENER** — Worthington Pump & Machy Corp, Water-Treating Section, Dunellen, N. J. 16-page catalog No. W-212-B5 gives information on the company's new cold-process slurry-type precipitating water softener and coagulator employing hy-

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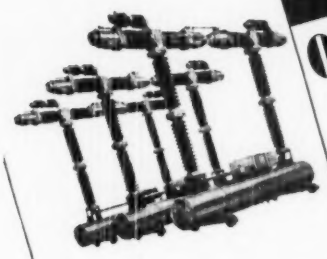

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Please send me specifications and details on your ☐ indoor ☐ outdoor air blast breakers for ____kV ____ Amps. ____kVA.

Name _____ Title _____

Company _____

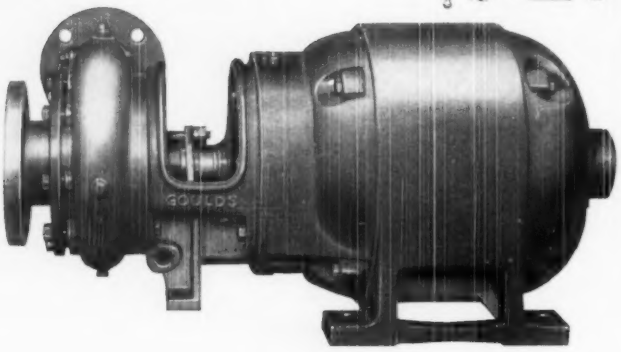
Address _____

BROWN BOVERI

BROWN BOVERI CORP., 19 Rector St. • New York 6, N. Y.

FOR A LOT OF PUMP

IN A SMALL PACKAGE



Goulds "Close-Cupld"

This efficient, advanced design pump gives the operating man many advantages that eliminate liquid transfer problems.

The pump and motor are a compact unit. The single shaft maintains perfect alignment and the unit is vibration free. You don't need a bedplate.

All you do is set the "Close-Cupld" in place, connect it up and turn on the current.

Sizes and Capacities:

We make the "Close-Cupld" in 17 sizes with capacities up to 2000 G.P.M., heads up to 400 ft. depending on capacities.

Send for a free copy of Bulletin 701.1 today. It gives you complete data on Goulds "Close-Cupld" pumps.

MEMBER HYDRAULIC INSTITUTE U.S.A.

Goulds PUMPS INC.
Seneca Falls
New York

draulic energy for mixing the applied chemicals with previously formed precipitate.

X11 EQUIPMENT AVAILABLE — Graver Water Conditioning Co, Dept 114, 216 W 14th St, New York 11, N. Y. 8-page bulletin No. WC-100 explains the scope of Graver activities and illustrates some of the company's large installations of hot-process and zeolite softeners, demineralizers, clarifiers, filters, etc.

WELDING

Y10 SUBMERGED WELDING—Linde Air Products Co, 30 E 42nd St, New York 17, N. Y. 36-page booklet, entitled "Unionmelt Apparatus Catalog," contains latest information on Unionmelt apparatus and supplies for submerged melt welding. Sections added include portable DS welding head, the shape-welding carriage, and the flexible welder.

Y11 SOLDERING PRODUCTS — P Wall Mfg Co, 411 Erie St, Grove City, Pa. 24-page catalog No. 85 presents the complete line of Wall soldering products. Items described are: gasoline and kerosene blow torches, self-generating alcohol blow torches, electric-soldering irons, solder, splicer's furnaces, paraffin supplies and compound kettles.

Y12 LOW-HEAT WELDING—Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N. Y. 8-page 1950 directory of Eutectic products for low-heat welding of all metals. A complete selection chart is also included for information on numerous specialized Eutectic welding alloys for particular jobs.

OTHER EQUIPMENT

Z24 HEAT EXCHANGER — Ross Heater & Mfg Co, Inc, 1407-1411 West Ave, Buffalo 13, N. Y. 4-page folder No. 1-7K1 describes the new fully standardized series Type S8CF all-stainless steel heat exchangers. Line drawings and dimension tables are furnished.

Z25 INSULATED PIPE—Durant Insulated Pipe Co, 1015 Runnymede St, Palo Alto, Calif. 40-page book covers Durant presealed insulated pipe for use in underground and exposed locations. Construction details and specifications are given.

Z26 DISK WHEEL—Raybestos-Manhattan, Inc, Manhattan Rubber Div, Abrasive Wheel Dept, Passaic, N. J. Bulletin No. 6901-A describes Manhattan Moldisc, a bonded disk wheel for rotary sanders.

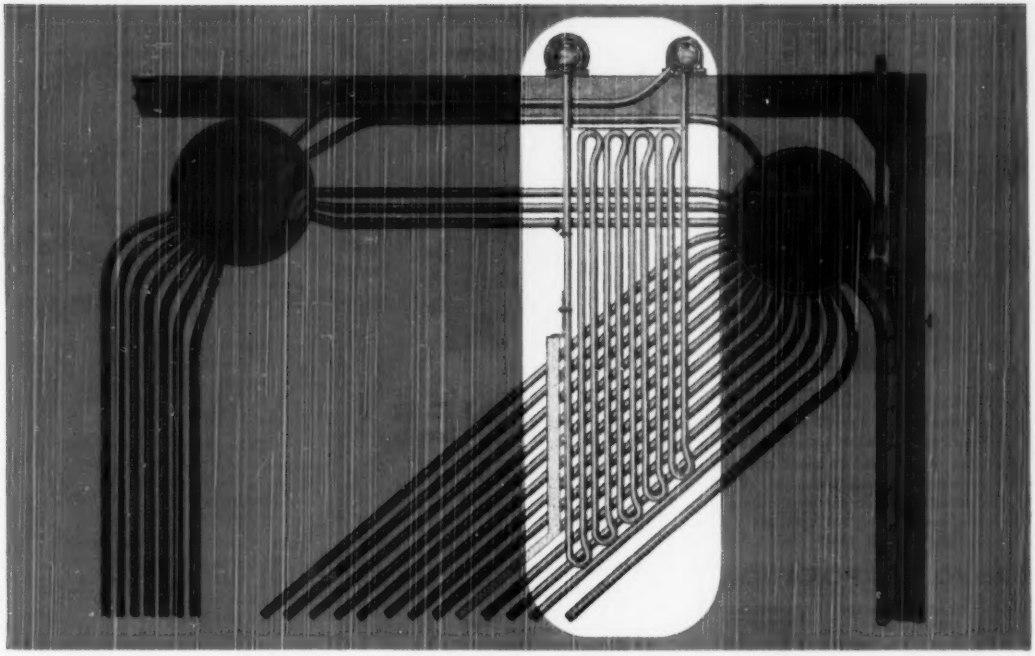
Z27 INDUSTRIAL CLAMP — Hunter Spring Co, 1 Spring Ave, Landsdale, Pa. 4-page folder No. 310-1C contains principles, characteristics, price list, and illustrated applications of the Neg'ator industrial clamp.

Z28 SCALE MODELS — Raymond A Lester Associates, 39 E Prospect Ave, Mount Vernon, N. Y. 8-page brochure shows a few of the many uses for scale models in business and industry.

Z29 MATERIALS TEST—South Florida Test Service, 4201 N W 7th St, Miami 34, Fla. 8-page pamphlet explains the scope of service offered by the firm for testing durability and permanency of materials.

Z30 NEW AND USED EQUIPMENT —Charles Weaver, 4145 Penobscot Bldg, Detroit 26, Mich. Series of bulletins describing new and used equipment including steam turbines, turbine-generators, diesels, boilers, etc. Specifications are given.

Powermatic Ventilator Co has announced a change of name. The new name, Iron Lung Ventilator Co, incorporates the company's trade name for its several types of industrial ventilating equipment. Headquarters remain at 4019 Prospect Ave, Cleveland 3, Ohio.



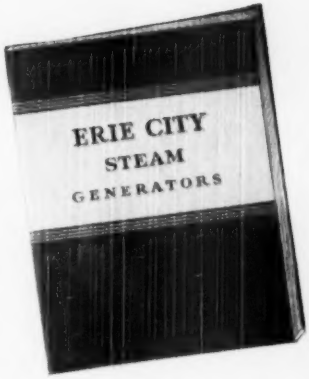
THE ERIE CITY SUPERHEATER

The illustration above shows one of the many types of superheaters designed and produced by Erie City to meet the exacting requirements of the modern steam generator. This particular example is the vertical pendant type.

The horizontal steam take-off serves also as the superheater inlet header, thus making the superheater an integral part of the boiler and simplifying installation and maintenance.

This familiar method of taking steam from an Erie City boiler in a transverse series of tubes, instead of a single nozzle, produces steam with high initial dryness and allows the superheater to perform with maximum efficiency and safety.

Our Steam Generator Bulletin (SB-30) illustrates and describes many types of superheaters engineered and manufactured within our own plant. It is available on request.



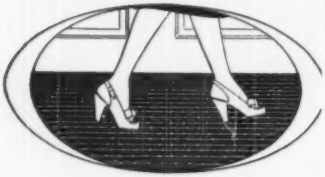
COMPLETE STEAM POWER PLANT EQUIPMENT

ERIE CITY

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

THE **SAFE**
OPEN STEEL FLOORING
IS **TRI-LOK**



No object over ½ square inch can pass through super-safe U-Type Tri-Lok Flooring. Fabricated without bolts, rivets or welds, it is unsurpassed for plant installation, walkways, loading platforms. Efficient distribution of concentrated loads . . . maximum free opening for light and air. Write for Bulletin JZ 1140.

DRAVO CORPORATION

National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

Sales Representatives in Principal Cities

DRAVO

High Pressure Steam at Low Cost

SCOTTIE JR®

KEWANEE®

6 sizes for 6 to 36 hp at 100 lbs wp . . . For coal, oil or gas . . . hand or mechanically fired.

Check the proportions of each Scottie Jr. and you'll see why it will actually produce approximately double the horse power guaranteed by its rating.

WRITE Department 99-KJ
for 6" scale with pipe diameter markings

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

Branches in 68 Cities—Eastern District Office: 60 West 40th Street, New York City 18
Division of American Radiator & Standard Sanitary Corporation

YOU CAN CUT PIPING COSTS with
CATAWISSA PERFECT SEAL UNIONS

CATAWISSA
HOT FORGED STEEL UNIONS
priced to compete with better grade malleable iron unions

also . . . DOUBLE EXTRA HEAVY FORGED STEEL
SWING CHECK VALVES
600-lbs. W.S.P.

a type for every use!
CATAWISSA
STAINLESS STEEL UNIONS
machined from solid bars

WRITE FOR BULLETIN 10-A

CATAWISSA VALVE & FITTINGS CO.
206 Mill St. • CATAWISSA, PA.

COMING EVENTS

Jan 16-19—Plant Maintenance Show, Auditorium, Cleveland, Ohio, Clapp & Poliak, Inc, 341 Madison Ave, New York 1, N. Y.

Jan 23-27—Southwest Air-Conditioning Exposition of the International Heating and Ventilating Exposition, State Fair Park, Dallas, Texas. Sponsored by American Society of Heating and Ventilating Engineers simultaneously with their 56th annual meeting. Charles F Roth, International Exposition Co, Grand Central Palace, New York 17, N. Y.

Jan 30-Feb 3—American Institute of Electrical Engineers, annual meeting. Statler Hotel, New York, N. Y. R S Gardner, AIEE, 29 W 39th St, New York 18, N. Y.

April 5-7—Midwest Power Conference, Sherman Hotel, Chicago. Ill. Dr E R Whitehead, secy, Illinois Institute of Technology, 3300 S Federal St, Chicago 16, Ill.

April 12-14—American Society of Mechanical Engineers, spring meeting, Statler Hotel, Washington, D.C. O B Schier, ASME, 29 W 39th St, New York 18, N. Y.

April 19-20—American Institute of Electrical Engineers, Power Conference, Statler Hotel, New York, N. Y. R S Gardner, AIEE, 29 W 39th St, New York 18, N. Y.

POWER'S History

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam*, which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine*, *Home Study for Machinists*, *Mechanic's Magazine*, *Home Study for Building Trades*, *Building Trade's Magazine*, *Home Study for Electrical Workers* and *Steam Electric Magazine*.

In 1908 POWER absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago, the latter being a consolidation of *The Safety Valve*, *Lord's Power and Machinery Magazine*, *The Stationary Engineer*, *Steam Engineering* and *The Mechanical Engineer*. When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer*. The title was condensed to POWER in 1911. All rights to the preceding titles reserved.

Victor Equipment Co has bought out the business and assets of the Mills Alloys, Inc in Los Angeles, Calif. Mills Alloys has made all types of blasting nozzles and tungsten-carbide hard-surfacing rods.

These are the tubes...

that stay on the job

CHASE

ANTIMONIAL ADMIRALTY

(a patented alloy)

Chase Antimonial Admiralty has been in use for 14 years, withstanding the test of time — *because* the percentage of antimony is *right*.

Admiralty containing less than .007% antimony (the minimum set forth in Chase Patent No. 2,061,921) cannot be counted on to prevent dezincification under all conditions. Over a wide range of applications, .015% is the minimum. Chase makes doubly sure you get this percentage—by using a nominal content of .035%, so that even with normal commercial variation your tubes contain at least .015% antimony.

That's why Chase patented Antimonial Admiralty tubes stay on the job, year after year. Get the facts!

Special stocks of
ANTIMONIAL ADMIRALTY
Condenser Tubes in Chase Warehouses:
NEW YORK, BALTIMORE, NEW ORLEANS
LOS ANGELES, SAN FRANCISCO
also carried by—
Vinson Supply Co., Tulsa
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the Nation's Headquarters for
BRASS & COPPER

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THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

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for power plant men
Become a trained combustion Engineer the easy HAYS way.

Firemen, engineers, fuel and equipment men, etc., can earn bigger pay by becoming a Hays trained combustion engineer. Many employers recognize a HAYS-TRAINED engineer as a better man. Just a little of your spare time required for the easy - reading Hays Home Study Course. Hundreds of others have made better jobs for themselves through Hays training. So can YOU.

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"Our best ads are installed . . ."

A battery of 20 14' x 25' wood stave tanks

COOLING TOWERS
WOOD TANKS
STAINLESS TANKS
WOOD PIPE
MULTI-FIN UNITS

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LOCKETT FUEL OIL PUMPING AND HEATING SETS

Custom Built

The compact, high-pressure unit illustrated consists of two Worthington Duplex Steam Pumps and three Griscom Russell Twin G-Fin Fuel Oil Heaters mounted on a single structural steel frame.

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump is suitable for the full rated capacity of the unit; and one heater section is a spare. Lockett supplies everything, complete. *Inquiries are invited. Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS - HOUSTON - DALLAS - GALVESTON

APPOINTMENTS

General Electric Co names the following men to new positions in its Apparatus Dept: Neil Currie Jr, administrative assistant to general manager; Ernest E Johnson, manager of engineering, large apparatus divs; Carl A Salmonsen, manager of manufacturing, large apparatus divs; Byron A Case, manager of engineering, small apparatus divs; Frank T Lewis, manager of manufacturing, small apparatus divs; Clarence H Linder, assistant to general manager; C W LaPierre, manager, aircraft gas-turbine divs. Also, C W Bryant becomes purchasing agent of purchasing dept's ferrous products div and is succeeded by K N Bush as assistant production manager in the Apparatus Dept.

Richard Cutts Jr is named manager of sales for central station divs of ***GE's*** Apparatus Dept. Donald E Craig suceeds Cutts as assistant manager of sales for the meter and instrument divs at Lynn, Mass. Simultaneously, four managers of sales for different sections of the central station divs are announced as follows: E N Chilberg, eastern section; R R Owen, western section; J W Dodge, government section; and L B Proctor, rural electrification administration section. All, with exception of Craig, will be headquartered in Schenectady. Also, D S MacDonald is now assistant to the manager of gear motor sales div of small and medium motor divs.

Yarnall-Waring Co, Philadelphia, has transferred John A Steer to replace Harold S Webster, retired, as district manager in New York. Also, J B Ambler has been appointed sales representative in the Denver district.

H R Pursel assumes new duties as head of **Beaumont Birch Co's** hydraulic materials-handling systems dept, Philadelphia.

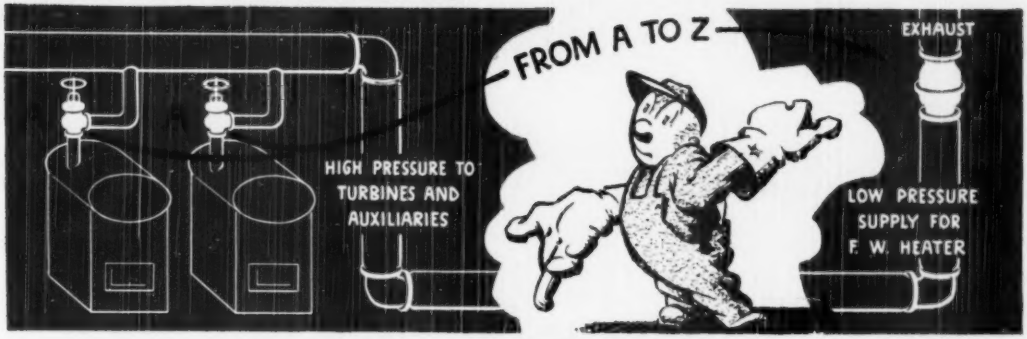
Superheater Co, Ltd, Montreal, Canada (in conjunction with its affiliate, Combustion Engrg Corp, Ltd) has been appointed to represent **De Laval Steam Turbine Co** in the Provinces of Newfoundland, New Brunswick, Nova Scotia, Prince Edward and Quebec. In addition, a new De Laval district office has been opened in Tulsa, Oklahoma, under management of Harold Meyer. Lefler Wymont Supply Co, Casper, Wyo, will be the representative in Wyoming and Montana, and Roger Brown Co, El Paso, Texas, in southern New Mexico and southwestern corner of Texas.

Fairbanks, Morse & Co assigns Harold D Gobble to succeed Harry J Renken as manager of its Dallas, Texas branch house. Renken is transferred to company's headquarters in Chicago to become oil field division manager. Russel A Stevens replaces V O Harkness as manager of Boston branch house. Harkness assumes duties as diesel sales-dept manager for Boston area.

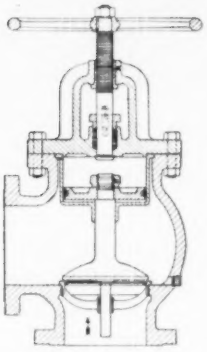
Homer A Goddard Jr has been named assistant general manager for industrial marketing for **Gulf Oil Corp,** Pittsburgh, Pa.

Graybar Electric Co has chosen C S Powell to replace R W Kimberlin as St.

SAVE MONEY IN YOUR PLANT



—with FOSTER AUTOMATIC VALVES



FOSTER AUTOMATIC NON-RETURN Stop and Check Valve, Type 2

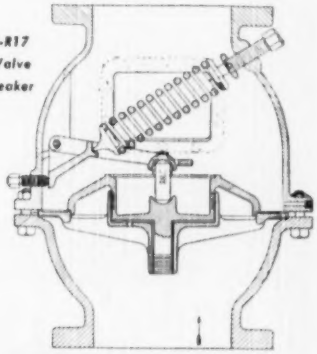
A . . . On your boiler drums, Foster Automatic Non-Return, Stop and Check Valves save money by doing their job perfectly—with the absolute minimum of attention—for years. It is not unusual to find these valves still giving good service after 25 or 30 years and more. Today's valves are even better.

There's nothing skimpy about a Foster Type 2. Full pipe area means negligible pressure drop across the valve. Heavy duty, through bolted construction makes it safe to work under when the boiler is down. Low pressure types to 250 lbs. (stocked) have semi-steel bodies, bronze trimmed, with stainless steel seat rings; high pressure types to 1,500 lbs. have cast steel bodies, trimmed with special heat resisting, corrosion resisting alloys. Piston chambers are renewable. They're built for lifetime service. Globe, angle, or elbow, from 2½" to 12".

Z . . . The R-17 Back Pressure Valve saves money by keeping the pressure where you want it on the exhaust side—for your feed water heater or other low pressure equipment—with a minimum of maintenance. Large pipe area, and large valve area mean low pressure drop across the valve, and sensitive action at low pressures. Saves make-up steam. Adjustable in ounces.

The R-17 has no outside stuffing boxes or external weights. Loading spring is on the atmosphere side of the valve and is accessible for inspection through a large handhole. Renewable seat ring and dash pot. 2½" to 20", (with sizes from 4" to 12" stocked).

Foster Type 34-R17 Back Pressure Valve and Vacuum Breaker



• • •All along the line—Foster Pressure Regulators, Temperature Regulators, Pump Governors, Float Valves, Safety Valves, Check Valves, Relief Valves and Safety Valves are designed and built to save money, by giving reliable, trouble free regulation with a minimum of maintenance. When you select the proper Foster Valve and install it correctly, you are making a sound investment, backed by more than 70 years of practical experience in building good valves, and our reputation for service.

FOSTER ENGINEERING Company

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . AUTOMATIC STOP AND CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SAFETY VALVES . . . SIRENS

835 LEHIGH AVENUE • UNION, N. J.

now available . . .

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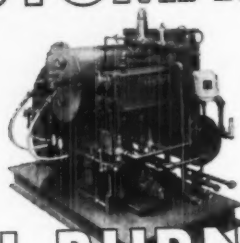
AUTOMATIC

OIL BURNER

PUMPS · HEATS · IGNITES
BURNS HEAVY FUEL OIL · FULLY AUTOMATIC
ALL IN ONE UNIT

DESIGNED ENGINEERED AND MANUFACTURED BY
PEABODY ENGINEERING CORPORATION
BULLETIN 400

Write for
complete, detailed description
of the new PEABODY
AUTOMATIC BURNER
Bulletin 400

PEABODY
ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers.
OFFICES IN PRINCIPAL CITIES

Louis district manager. Kimberlin moves to San Francisco as district manager. He will assume duties relinquished by J P Carson, who retired on service pension.

Industries Service & Equip Co, 822 W 34th St, Erie, Pa., will represent **Dampney Co of America** in counties of Erie, Crawford and Warren, Pa.

Hewitt-Robins Inc, New York, appoints Edwin M Perrin advertising manager. A P DeVita becomes New York district sales manager for the firm's Robins Conveyors Div. Also, Austin Goodyear is now assistant to B T Moffatt, vice-president in charge of sales. Other appointments are: C A Thompson, Charleston district sales manager and C W Brooks, Virginia-North Carolina sales territory, handling both Hewitt Rubber and Robins Conveyors division products.

Stephen F Curtis has been designated director of purchasing for **Johns-Manville Corp,** New York, succeeding Norman O Aeby, retired.

Lunkenheimer Co, Cincinnati, Ohio, elects Paul M Arnall vice-president and general manager.

Koppers Co Inc, Pittsburgh, Pa., has named Fred Denig manager of production dept and Dr G Frank D'Alelio manager of research dept. Dr A R Powell has become associate manager of research dept. Hugh C Minton, who previously headed up the production dept, has resigned because of ill health.

Six distributors for new Nordberg 4FS-1 diesel engine are announced by **Nordberg Mfg Co** as follows: Al-Pac Engine & Equip Co, Seattle, Wash.; Atlantic Engine Supply Inc, Boston, Mass.; Bolinders Co Inc, New York, N. Y.; H G McKinney & Co, Wilmington, Calif.; Northwest Distributors, Ltd, Vancouver, B. C., Canada; and J N Vernam Co, Miami, Fla.

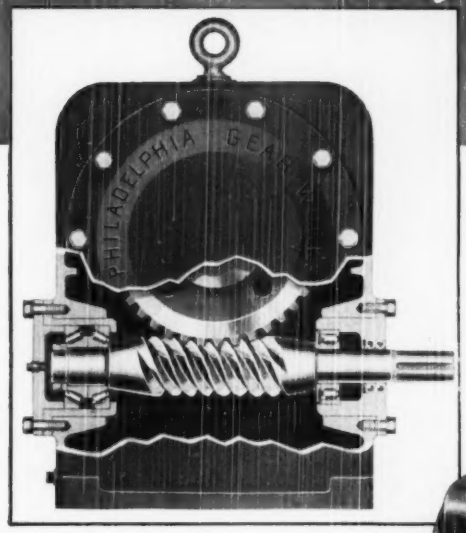
Swartwout Co has chosen Willian R Robinson as Pittsburgh district manager, power-plant equipment div, with offices at 3400 Forbes St. He succeeds Robert J Jones, now New York district manager. Richard J Frost has been promoted to district manager in Philadelphia. Also, henceforth, the power-plant equipment div in New York will function as a factory sales branch office.

A M Shaw is now assistant manager, pump and compressor merchandising div, of **Worthington Pump & Machy Corp,** Harrison, N. J. Shaw will be responsible for development of pump and compressor sales to original equipment manufacturers.

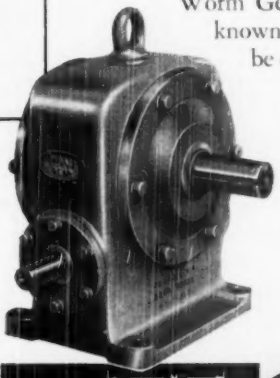
Electric Products Co has chosen William E Brice Co, Houston, Texas, as its district representatives for southern Texas.

Westinghouse Electric Corp, Pittsburgh, announces following appointments: A A Johnson succeeds Dr Charles F Wagner as manager of central station engineering in the industry engineering dept. Wagner is now consulting engineer for the firm in central station and power fields. M L

WHAT MAKES A *Good* WORM GEAR SPEED REDUCER?



Any Speed Reducer is only as good as the *experience* and the *manufacturing facilities* of its manufacturer . . . these factors, plus world-wide acceptance of Philadelphia Worm Gear Reducers, presupposes that these units must be *efficient, rugged and as trouble-free as possible.* In fact, Philadelphia Worm Gear Reducers embody every known mechanical feature that can be considered important for the efficient transmission of power, under all conditions. We offer every type, size and reduction ratio of Worm Gear Speed Reducer.



FEATURES . . .

OF THE TYPE A-T-O AND R-T-O PHILADELPHIA WORM GEAR SPEED REDUCERS

May be had with Worm "above" or "below" the Worm Wheel.

Worms are made of alloy steel with carburized, hardened and tempered threads—both shaft and threads are accurately and smoothly ground after heat-treatment.

Worm Wheels are of highest quality chill cast nickel-bronze.

Bearings are anti-friction types (ball or roller) best suited for smooth, quiet, trouble-free operation (see cut-away illustration).

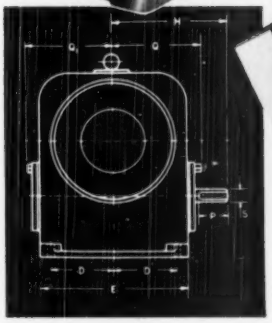
Housings are of "one-piece," quality grey iron—compact, neat, rigid and of ample radiating surface to prevent overheating.

All units carry A.G.M.A. rating.

Easy accessibility for removal of either Worm or Worm Wheel assemblies, from the one-piece housing.

Lubrication by splash system to all moving parts, in oil-tight housing.

Efficiencies as high as 96%.



Our Catalog No. 26 will give you full details on Worm Gear Speed Reducers. Please write for a copy on your Business Letterhead.

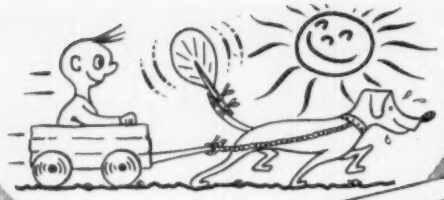
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

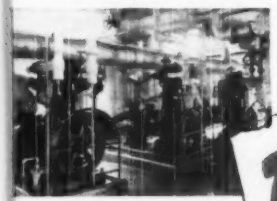


What Other Drive Gives You...

1. BY-PRODUCT POWER

Power to drive pumps, blowers or stokers... auxiliary electrical supply for special needs... off-peak or standby generating capacity—these can be obtained almost free by utilizing the By-Product Power available through Troy Steam Engines.

Steam used for heating or processing packs plenty of horse power as well as B.T.U.s. Under the right conditions, Troy Steam Engines can extract this latent power while actually improving the heat balance. By-Product Power can be converted into A.C. or D.C. electricity by efficient Troy Generating Sets, or it can be utilized directly to drive stokers, fans, pumps, blowers, kilns, compressors, mixers and similar equipment. With the Type EN Governor, constant speed can be maintained accurately; or speed can be automatically varied over an exceptionally wide range.



Double duty: Steam drives high pressure pumps and provides heat for processing in this installation of multiple Troy Steam Engines in the Port Arthur refinery of The Texas Company.

Plus—

2 HIGH STARTING TORQUE

3 UTMOST FLEXIBILITY

4 SIMPLICITY, LONG LIFE

5 ACCURATE, FAST SPEED CONTROL

Which Do *You* Need?

If your drive needs any or all of these five characteristics, the *modern* Troy Steam Engine is indicated. Send us your drive requirements and steam conditions, and our engineers will be glad to recommend the right type and size Troy engine to meet your needs.

Send for Bulletin 306

TROY

Troy Engine & Machine Co.

Power Equipment Division

2501 RAILROAD AVENUE • TROY, PENNSYLVANIA

Gardner replaces F P Taugher in Boston as engineering and service manager of New England district. Taugher is made manager of engineering, industrial control div. C H Bartlett assumes duties of sales manager for entire transformer div at Sharon, Pa., and is succeeded by J L Cross as manager of power-transformer sales. Thomas A Daly becomes engineering manager in charge of all naval ordinance work of Westinghouse, also at Sharon. In addition, Marvin W Smith, president of Baldwin Locomotive Works, is elected a director of the corporation.

Stephen C May is named vice-president and general sales manager of **Blackmer Pump Co,** Grand Rapids, Mich.

Morse G Dial and Kenneth H Hannan have been elected director and secretary, respectively, of **Union Carbide and Carbon Corp,** New York City.

Eugene P Berg has been promoted to assistant general manager of **Link-Belt Co's** Pershing Road plant in Chicago and Richard Moyer to general superintendent, manufacturing dept.

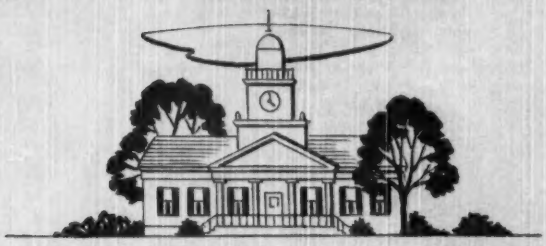
Anthony H Lamb is elected vice-president of **Weston Electrical Instrument Corp,** Newark, N. J., and will assume responsibility for operation of the company's Tagliabue Div, reporting directly to the president.

Manning, Maxwell & Moore, Inc, increases its membership of the Board to thirteen. New members are: C A Moore III, general manager of instrument, manufacturing and repair div, Jersey City, N. J.; H S Moore, director of engineering, Bridgeport, Conn.; C M Chester III, treasurer, Bridgeport, Conn.; E M Moore, district manager, Pittsburgh district; J R Kelley, executive vice-president, New York, N. Y.; J E Minty, vice-president and general manager of Shaw-Box div, Muskegon, Mich.; and H Merrill, vice-president and acting general manager of Consolidated Ashcroft Hancock div, Bridgeport, Conn.

Eugene M Smith has joined **Youngstown Sheet & Tube Co** as flat, rolled products development engineer and will be located at the Campbell plant. Ernest Holme has been promoted to superintendent of Indiana Harbor rolling mills, replacing J M Mitchell, wo left the company. Also, James W Kirkpatrick has become chief metallurgist for the firm in the Youngstown, Ohio district.

Dayton Rubber Co, Dayton, Ohio, names Carl W Priesing vice-president and general sales manager, and Leonard C Strobeck vice-president in charge of mechanical sales.

Enterprise Engine & Foundry Co selects Power Equipment Co, 4706 Holly St, Kansas City, Mo., as its new engine sales representative in the Midwest replacing former district office at Omaha. Territory served will be western Missouri, Iowa, Minnesota, North and South Dakota, Nebraska, Kansas, Oklahoma, Arkansas, Colorado and New Mexico. In addition,



YOUR COMMUNITY

needs the safety

and lasting dependability of

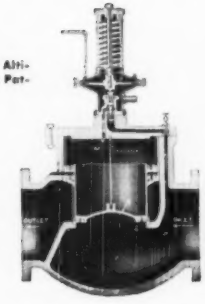
GOLDEN-ANDERSON

positive control **VALVES**

Sensitive Golden-Anderson Altitude Control Valves maintain water levels within 3" to 12" variations, and may be arranged with special equipment to perform a variety of other services.

Inherent water cushioning prevents shock or jar under varying flow conditions. These Valves are easily adjusted for any water level, and include an indicator which shows piston position at all times. Some models actually are two valves in one—a regular automatic Altitude Control Valve as well as a Reverse Flow Check Valve.

Let Golden-Anderson protect life and property through *absolute, safe control* of difficult flow conditions.



G-A Single Acting Altitude Valve, Globe Pattern.

GOLDEN-ANDERSON *Valve* Specialty Co.
Keenan Building, Pittsburgh 22, Pa.

LIFE AND PROPERTY PROTECTION
VALVES SINCE 1905

Check Your Paint-Stripping Problem HERE

- ☐ How can we strip baked-on primer coats without resorting to expensive thinners and solvents?
- ☐ Do you have a good idea that'll speed up the removal of toluene-thinned, asphalt-based paints from underground transformers?
- ☐ We've had a slew of armature coils in the shop for months, waiting for an economical way to strip insulating varnish . . . what do you have?
- ☐ Other headaches.

NAME.....

ADDRESS.....

COMPANY.....

Power plant paint-stripping can be done easily and quickly if the proper stripping compound is selected—then applied as recommended. Take transformer stripping, for example. Your nearby Oakite Technical Service Representative can show you a number of job-proved methods, including hot flow-on, cold spray, steam-gun and tank-immersion techniques. He'll help you select the Oakite method best suited to your lay-out . . . help you find a simple way to save time and money on the job.

Let us have your paint-stripping problems (whatever they might be). We'll ask the Oakite Technical Service Representative in your vicinity to visit your plant and talk them over with you. Or, if you'd like to have some factual data about fast Oakite paint-stripping procedures first, send for a complimentary copy of the Oakite Power Plant Digest of 71 maintenance-cleaning procedures. Oakite Products, Inc., 23 Thames St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

Ed Allison, service engineer, formerly attached to Omaha district office, will headquarter at Power Equipment.

Following retirement of G L Ringland, chief engineer of electrical dept at **Allis-Chalmers'** Norwood Works, the following appointments were made: F M Winterhalter, engineer-in-charge of ac design; C F Cobb, engineer-in-charge of dc design; E K Spooner, insulation engineer; I C Smith, mechanical engineer; and W T Saveland, assistant mechanical engineer.

Ray P Johnson is now administrative assistant to G A Shallberg, executive vice-president of **Borg-Warner Corp,** Chicago. William J McQuillan is promoted to branch manager, Pittsburgh office of Morse Chain Co, div of Borg-Warner.

American Brake Shoe Co reports several appointments in its divisions as follows: Harry C Platt, vice-president, engineered castings div; William H Starbuck, vice-president, Kellogg Div; William J Grant, manager of Southern sales, National Bearing div, headquarters in Southern States Bldg, Richmond, Va.; Robert H Elem, Pacific Coast manager, Welding Products div, headquarters in Los Angeles, Calif.; and William C Bruton, district sales manager, American Manganese Steel div, headquarters in Oakland, Calif. Bruton's territory covers Pacific Northwest including the Yukon and Alaska.

Newton R Crum of Alhambra, is representing **Flexible Steel Lacing Co** in California.

Standard Pressed Steel Co designates George A Gade regional sales manager in charge of Midwest territories, with headquarters in Detroit. Succeeding Gade as Detroit district manager is Francis J Kinsella. David J Hurford becomes special representative for aircraft products in the West Coast area and is replaced by William C Harper as Cincinnati area district manager. A Clayton Graham assumes Harper's duties as representative in New England territory.

Fred Thilenius has been made manager for **France Packing Co's** newly created Mid-Continent district. Offices will remain at 303 E Fourth St, Tulsa, Okla., but now serve as sales headquarters for a much larger area, which includes the states of Kansas and Oklahoma, north and west Texas, including the Panhandle, and southeast New Mexico.

Holyoke Machine Co, Holyoke, Mass., has chosen I. H Perry to head its hydraulic dept.

Geo P Reintjes Co announces appointment of Interstate Sales Inc, Arcade Bldg, St. Louis, Mo., as its representative in the St. Louis area.

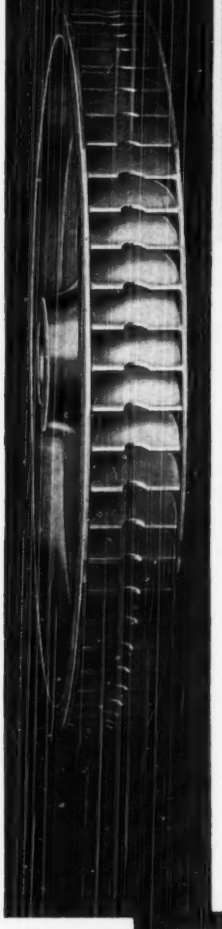
Balfour Guthrie & Co, Ltd, has been selected distributor for Borgana, newest product manufactured by **Portland Shingle Co.** Borgana, the new boiler treatment for prevention of scale and corrosion, will be distributed in all Western states, Alaska,

your industry's BIGGEST TRADE SHOW!

Your industry's biggest trade show isn't a once-a-year event. It comes to you with *every single issue* of this magazine. And, because it is scheduled so frequently, it can bring you a continuing series of up-to-the-minute "displays." In these advertising pages, you will find the latest news about products and services that are specially designed to help you do your job better, quicker, and cheaper. To be well-informed about the latest developments in *your* industry . . . and to stay well-informed . . . *read all the ads too.*

McGRAW-HILL PUBLICATIONS

TERRY



QUICK-STARTING
TURBINE
FOR FEED PUMP
EMERGENCY DRIVE

The turbine shown at the right picks up the feed-pump load in case the motor, which normally drives the unit, is inoperative. Thus the turbine must be able to start quickly and be completely reliable —characteristics which are assured by the generous blade clearances and one-piece construction of the Terry Wheel.

This is but one example of many special turbine requirements that are met by the Terry solid-wheel turbine. Details on how this and other Terry Turbines will meet your individual needs will be gladly supplied by a Terry engineer.

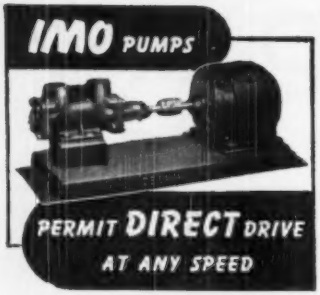
DATA

The turbine is 620 hp, 3550 rpm for 850 psi, 900F steam with 2.5 psi back pressure.

Installed in the Crawford station, Middletown, Pa., Metropolitan Edison Co. Gilbert Associates, Inc. were the consulting engineers.

T-1178

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



The IMO pump can be connected directly to turbines, motors or other machinery without the use of reduction gears.

Operated at high speed, it is exceptionally small and compact in proportion to its capacity.

IMO pumps can be furnished for almost any capacity and pressure required for pumping oil, hydraulic control fluids and other liquids over a wide viscosity range.

For further information send for catalog 1-138P.

IMO PUMP DIVISION of the DE LAVAL STEAM TURBINE CO. TRENTON 2, NEW JERSEY

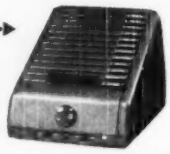
WATCH FOR SPECIAL SECTION ON MEASURING ELECTRICITY

* * * *

Your February issue of POWER will contain a 20-page comprehensive treatment on common types of portable and panel instruments to help you solve your measuring problems. This special section should prove invaluable in the understanding of how instruments and meters work, and how to fit them to your plant needs.

NEW INTERCOM can cut your Operating Costs—

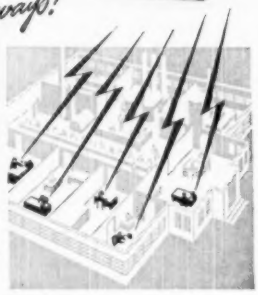
In a dozen ways!



IN THE OFFICE—Executone saves you time and money . . . by stepping up efficiency through interdepartmental communications, by quick exchange of information among all personnel, by eliminating "inside" calls that tie up your switchboard.

IN THE PLANT—by coordinating Production Control, by faster Materials handling, by improved Job Time Keeping—by uses of intercom that probably never occurred to you!

Your Executone Man has all the facts at his fingertips . . . gives you Executone's experience in hundreds of businesses. *Get the entire story*—no obligation.



Write Dept. A-6

Executone

COMMUNICATION & SOUND SYSTEMS

415 Lexington Ave., New York 17, N. Y.

British Columbia and Hawaii through Balfour Guthrie branch offices in Portland, Seattle, Tacoma, Spokane, Los Angeles and San Francisco.

A T Waidelich is now vice-president in charge of research for **Austin Co,** Cleveland, Ohio, engineers and builders.

Magnus Chemical Co Inc, Garwood, N. J., names J Dudley Holmes as a member of its board of directors.

Stanley Engineering Co, Muscatine Iowa, designates Sanford K Fosholt chief engineer. Franklin M Swengel joins the firm as head of mechanical section.

Marshall F Allen has been made manager of **Magnesia Insulation Manufacturers Assn.** He succeeds Utley W Smith, who resigned to accept a position with Ehret Magnesia Mfg Co. Allen's headquarters will be in Washington, D. C.

Edward C Meagher, treasurer, Texas Gulf Sulpher Co, New York, is re-elected president of **United Engineering Trustees Inc.**

Paul R Duffey, power engineer for Youngstown Sheet & Tube Co, Youngstown, Ohio, has been elected a "fellow" of **American Society of Mechanical Engineers.**

OBITUARIES

Francis Hodgkinson, 82, designer and builder of steam turbines and honorary professor of mechanical engineering at Columbia University, died Nov 5 in Toledo, Ohio.

Charles Volney Kerr, 88, inventor of first steam turbine used in the merchant marine, died Oct 30 in a Los Angeles hospital.

Russell A Peterson, 45, sales and advertising manager, Davis Regulator Co, Chicago, died Nov 20 as a result of a cerebral hemorrhage.

Carter Stanard Cole, assistant technical secretary of American Society for Testing Materials, died Nov 17 in Philadelphia, as a result of a severe heart attack.

Francis James Hood, 44, president of Ansul Chemical Co, Marinette, Wis., died suddenly Nov 10 while on a business trip to New York City.

T Gunter Smith, 47, Southeastern division manager, Walworth Co, Atlanta, Ga., died Oct 25, while attending a convention in Monroe, La.

Walter N Cargill, 72, New England representative of steam plant equipment manufacturers, died Nov 11 in Arlington, Mass.

Aluminum Co of America's new Pittsburgh skyscraper will have eight elevators capable of a speed of 1000 ft per min, and six with a speed of 800 ft per min. Westinghouse Elevator Div will install the equipment and all necessary signal controls.

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

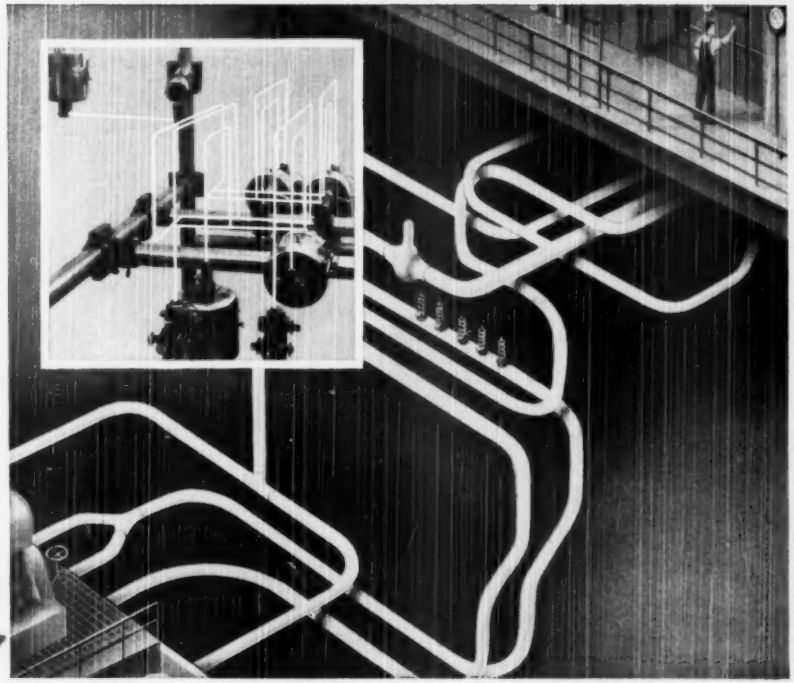
Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



Exclusive Equipment aids Seven New Power Installations

To be able to solve economically the exacting problems expected with the advent of future superpower stations, Kellogg's engineers and scientists some years ago began a search for a method of positively determining stresses and reactions in power piping.

Although the general mathematical method developed earlier by Kellogg is capable of solving problems of any complexity, the time required for computing the more intricate piping systems becomes impractical.

Here's what Kellogg eventually created—an exclusive, positive apparatus for accurate determination of stresses and reactions in the most complicated piping systems—a model tester, with specially-created and patented, electrical measuring heads.

Although this equipment was used on important work for the Navy during the war, the apparatus is now serving the purpose for which it was originally intended.

For example, with today's expansion and improvement in power generating stations, Kellogg has used the "tester" for analyzing the stresses in the re-heat steam cycle connections for the first two stations to operate on the re-heat cycle at 1000°F. Five additional proposed installations have been similarly studied, some of which will operate up to 1050°F. This makes a total of seven completed jobs with more "in the works" at the present moment.

Actual experience shows that the Kellogg Piping System Model Tester provides results that are borne out under actual operating conditions. Power engineers are able to take economic advantage of these analyses . . . permitting marked savings in material purchases.

The development of equipment such as this is another reason why Kellogg is enjoying so large a share of the critical, high-pressure, high-temperature piping business today.

If you are interested in further information on this advance in power piping design, Kellogg piping engineers will be glad to discuss it in detail with you.

To master temperature, pressure and chemicals use

M. W. KELLOGG

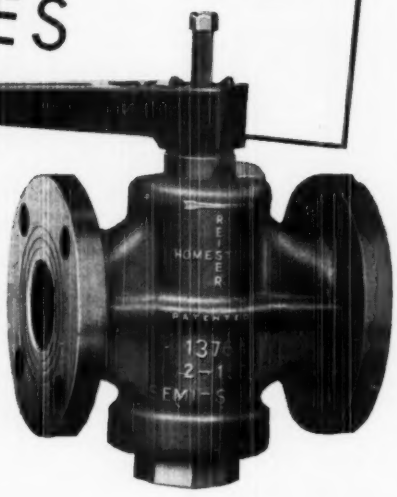
process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.)—Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

You can't buy A LOWER COST-PER-YEAR VALVE than

HOMESTEAD-REISER *Self-Sealed* LUBRICATED PLUG VALVES



They are the lowest-priced, full-port-area plug valves in their pressure and temperature range

And they *outlast* all other lubricated plug valves in their class. Every one of their many outstanding advantages including

100% area of standard pipe
100% lubricant seal around ports
Extreme economy of lubricant
Single lubricant for wide variety of applications, and
Self-sealing automatic adjustment for wear

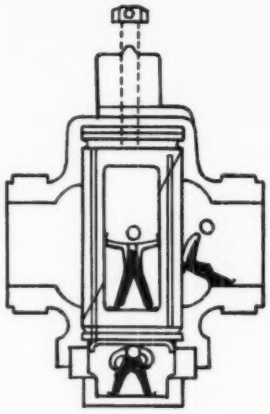
. . . are features asked for by engineers and operating men of industry.

Proof of their long, economical, dependable performance has been established in practically every industry during the past seven years. And at their new low price, they are more than ever your lowest cost-per-year fluid control.

Why not send today for your free copy of Valve Reference Book No. 39-5? *It shows sizes, types and pressure ratings for Homestead-Reiser Valves.*

How the "*Self-Sealed*" Principle Works

In addition to a full lubricant seal around the ports and around the top and bottom of the valve, the wedge-action of the plug under line pressure, constantly presses the finely-finished surfaces of the plug outward against the seating surfaces of the body. This self-sealing action keeps the plug surfaces in contact at all times with the mirror-like bore of the body. The plug thus automatically adjusts itself for wear, assuring extra long life and maximum leakless service.



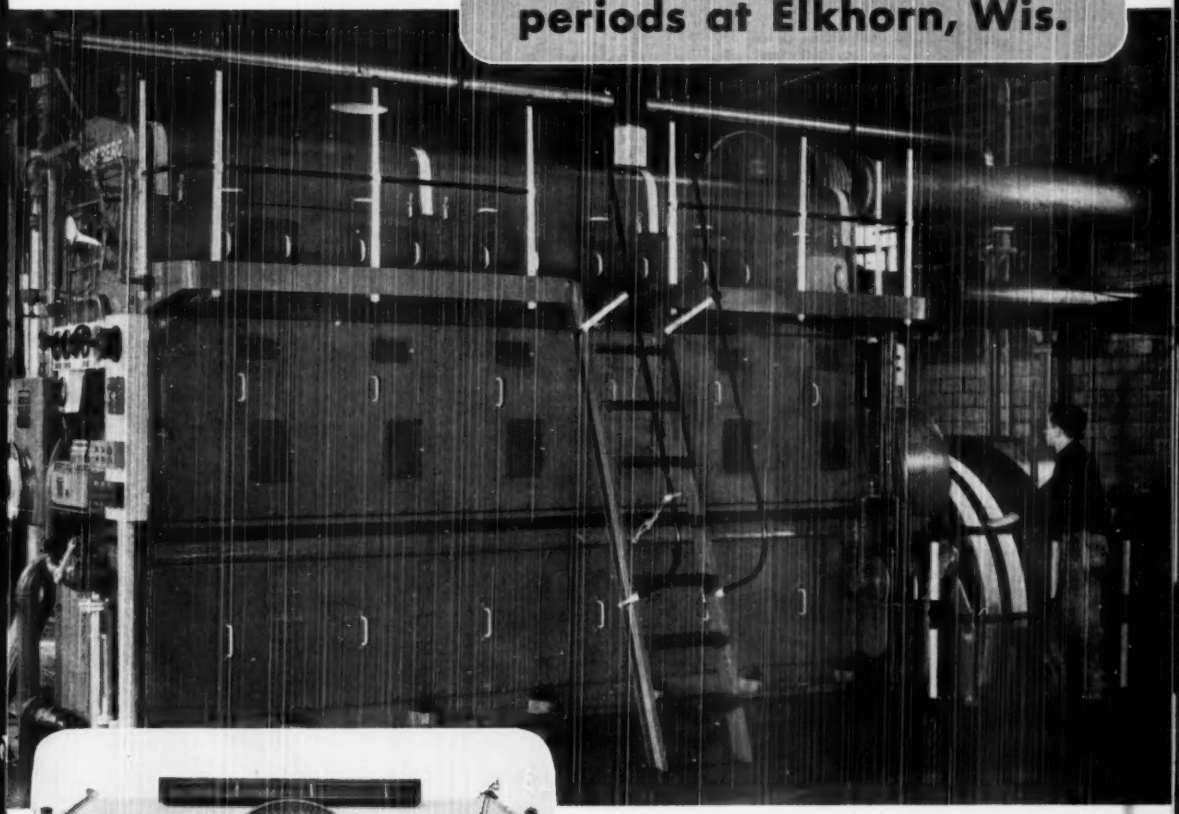
Write today for Reference Book 39—Section 5

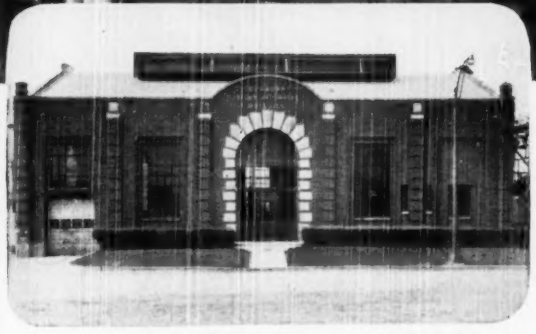
HOMESTEAD VALVE MANUFACTURING CO.

"Serving Since 1892" P. O. Box 210 Coraopolis, Pa.

NORDBERG GAS BURNING DIESEL

levels out peak demand periods at Elkhorn, Wis.





In addition to the type of engine installed at Elkhorn, Nordberg also builds a complete line of two and four-cycle Diesel units, in sizes from 10 H.P. to 8500 H.P., including both oil and gas burning types.

NORDBERG MFG. CO.
Milwaukee 7, Wis.

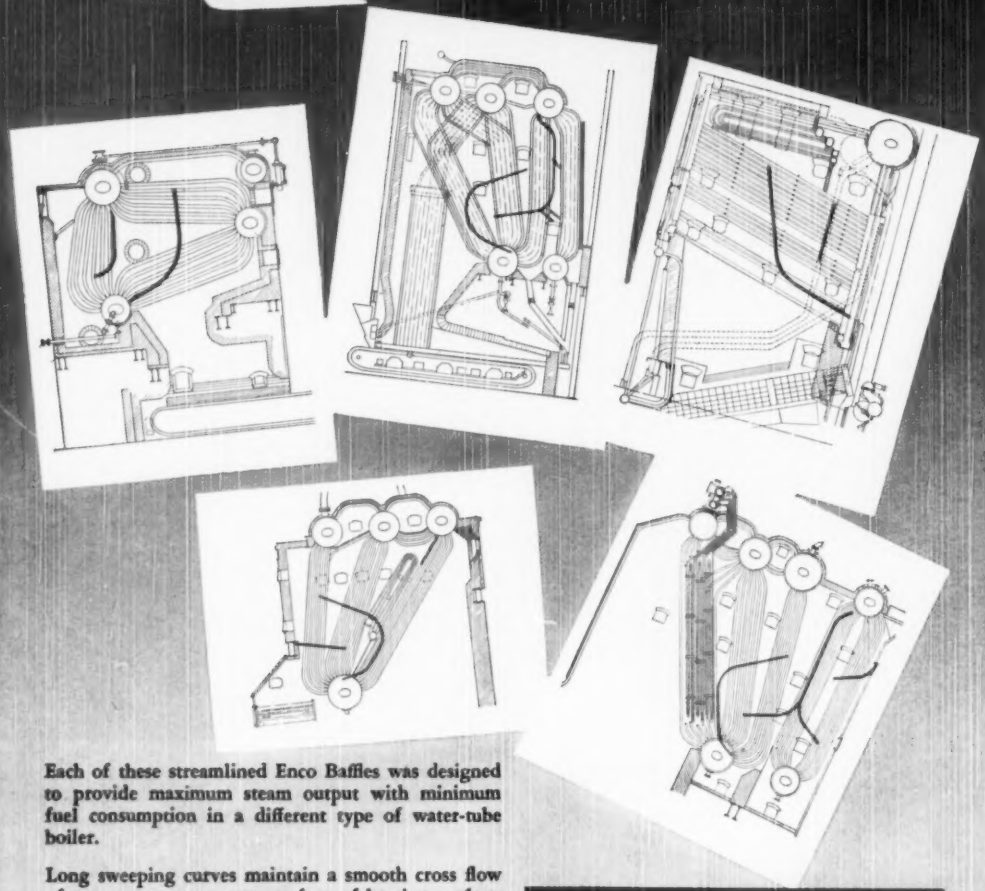
THIS Nordberg 1220 H.P. supercharged 4-cycle Engine is the first gas burning Duafuel Diesel to be installed in the state of Wisconsin. Serving the City of Elkhorn, this 6-cylinder, 875 K.W. unit carries a share of the total electrical load. Put on the line in early morning, it is operated until peak demand drops. Thus the high load "peaks and valleys" are leveled off by the Nordberg Duafuel Engine, operating on low cost gas fuel. In this way, the rate for the balance of purchased electric power is materially reduced.

This is just one example of the way in which the instantly convertible Nordberg Duafuel Diesels provide low cost power with equal economy on either oil or gas fuels.

Write for further information on a Nordberg Engine to meet your needs.

P150

Streamlined for Savings
IN EVERY TYPE OF BOILER



Each of these streamlined Enco Baffles was designed to provide maximum steam output with minimum fuel consumption in a different type of water-tube boiler.

Long sweeping curves maintain a smooth cross flow of gases across every square foot of heating surface. Eddy currents, bottlenecks and dead gas pockets are eliminated—draft losses are cut to a minimum. Soot blowers work more effectively, less steam and less time are needed for cleaning.

Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 18-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your FREE copy today?

The Engineer Company Produces:

ENCO OIL BURNERS

ENCO FUEL OIL PUMPING AND HEATING UNITS

ENCO AUTOMATIC OIL-ELECTRIC IGNITION SYSTEM

ENCO AUTOMATIC COMBUSTION CONTROL

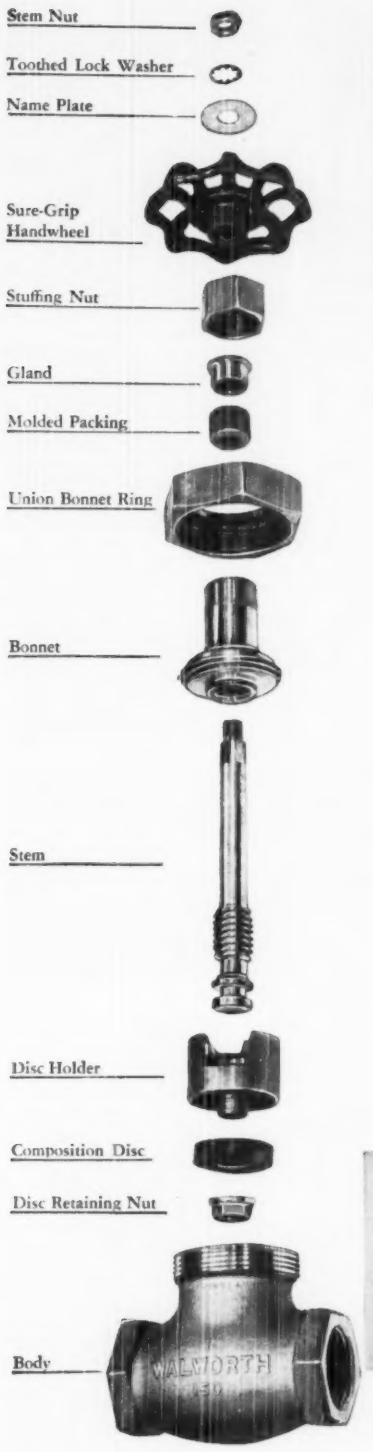
THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

Canadian Representative:

F. J. Raskin, Ltd., 370 Rachel E., Montreal, P. Q.

EC-473



TO MAKE A GOOD VALVE BETTER

Walworth has redesigned and improved its No. 95 Quality Bronze Globe Valve.

150 pounds working steam pressure at 500F

300 pounds cold water, oil, or gas.

Can be repacked under pressure when fully opened.

The Walworth No. 95 Bronze Globe Valve has always been tops with piping men because they liked these features: Renewable composition disc; lock-on, slip-off disc holder; union bonnet construction; deep stuffing box; tough bronze body made of Composition M (ASTM B61).

Now Walworth has added these improvements: (1) New cylindrical disc holder that accurately guides the disc to the seat, regardless of the position in which you install the valve. (2) Newly designed, air-cooled, sure-grip handwheel that you can grab and turn, even when wearing greasy work gloves. It has a tapered square hole sized to gage to fit snugly on the finished square of the stem. (3) Toothed lock-washer to prevent the stem nut from becoming loose. (4) All parts have been redesigned to give maximum service and strength.

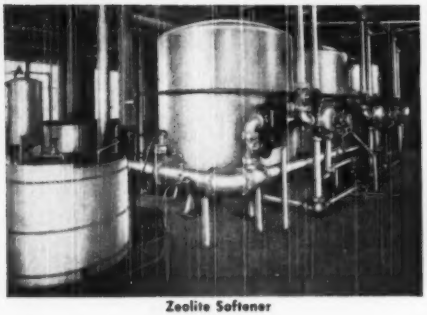
Walworth Quality Bronze Valves are available in Globe (No. 95), Angle (No. 96), or Check (No. 97) types and in sizes from ¼ to 3 inches (check valves ¼ to 2 inches). Ask your Walworth distributor to show you the improved Walworth No. 95 Bronze Valve, or write for further details.

WALWORTH

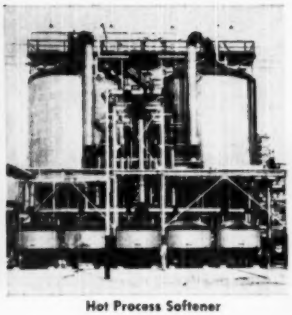
valves and fittings

60 EAST 42nd ST., NEW YORK 17, N. Y.

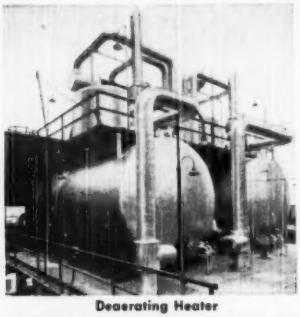
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD



Zeolite Softener

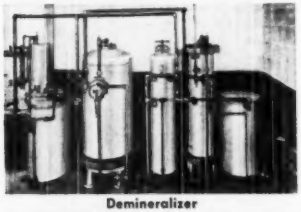


Hot Process Softener

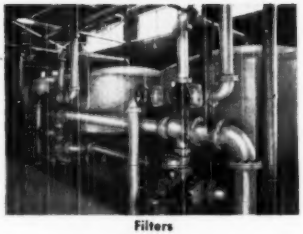


Deaerating Heater

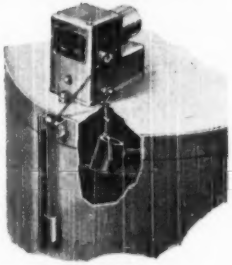
Reactivator Cold Process Unit



Demineralizer



Filters



Chemical Feeder

GRAVER

WATER CONDITIONING EQUIPMENT

IS

Accurately Engineered

to individual plant requirements

Backed By 40 Years of Experience

in design, fabrication and installation of all types of water conditioning equipment

AS WELL AS

Development and application of all types of water conditioning methods and processes

Write Today for Graver Catalogues

There is no obligation for analysis of raw water samples and our recommendations concerning specific problems.

GRAVER WATER CONDITIONING CO.

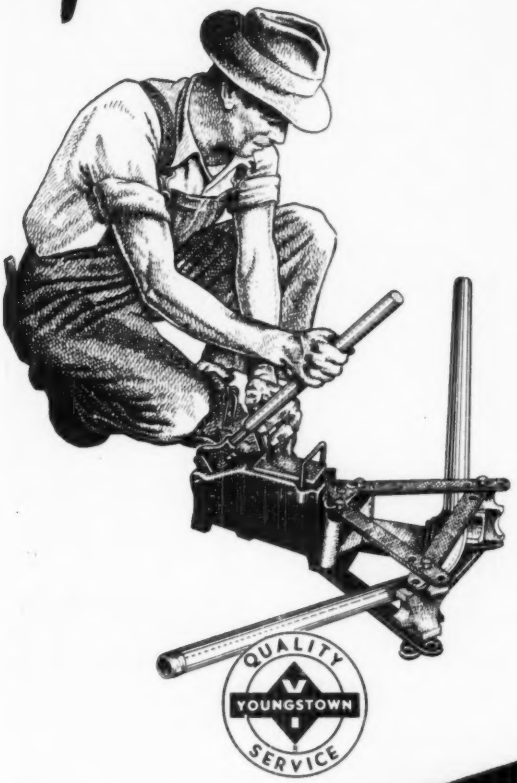
216 West 14th St., New York 11, N. Y.

CHICAGO • PHILADELPHIA • CLEVELAND

GRAVER

A DIVISION OF GRAVER TANK & MFG. CO. INC. EAST CHICAGO, IND.

Yes, it's Youngstown!



Dependable Steel Pipe
The Pipe-Fitters Friend

FOR 45 years, Youngstown Steel Pipe has served plumbing and heating contractors dependably--enabling them to furnish adequate water and heating systems to customers at lowest cost.

Whether you use a few feet or thousands of miles of Youngstown Steel Pipe, you can depend on its uniformity--uniform in metallurgical and chemical properties for easy, accurate bending, cutting, welding and threading--uniform in diameter and roundness--cut to uniform lengths--uniformly smooth inside for minimum friction--in short, *uniformly satisfactory.*

QUALITY · YOUNGSTOWN · SERVICE

Youngstown
STEEL PIPE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices — Youngstown 1, Ohio

Export Office - 500 Fifth Avenue, New York

PIPE AND TUBULAR PRODUCTS · CONDUIT · BARS · RODS · COLD FINISHED CARBON AND ALLOY BARS · SHEETS · PLATES · WIRE · ELECTROLYTIC TIN PLATE · COKE TIN PLATE · RAILROAD TRACK SPIKES.

LOOK BEYOND BTUs

when selecting Unit Heaters

* For maximum comfort and lowest operating cost, temperature of air leaving unit heater should be between 110°-120° F. at standard conditions.

Modine quieter operation is a result of scientifically sound-silencing air rush noises. Motor vibrations are effectively absorbed and dissipated by rubber mountings and resilient motor suspension.

Control of heat distribution on vertical models is provided by a built-in adjustable radial deflector assembly, furnished at no extra cost. You can beam, flood or gently diffuse heat as required.

Direct-from-pipe suspension without other supports is safe and practical with Modine Horizontal models. This cuts installation costs and permits easy redirection of heat over a 360° range.

Built-in Velocity generator effectively increases heat throw without increasing power requirements. Outlet air retains a large share of its initial velocity to penetrate cold air strata near floor.

Get new Modine Unit Heater Bulletin today! Also available — "How To Evaluate Unit Heater Performance Characteristics." Your Modine Representative listed in Classified section of phone book. Or write Modine Mfg. Co., 1512 Dekoven Ave., Racine, Wis.

Here's what you get with Modines!

• LOWER OPERATING COSTS

Modine Unit Heaters deliver heat down into comfort zones where heat is needed instead of wasting it on ceilings or above the heads of room occupants. *This means lower fuel costs!* Only unit heaters with sufficient air velocity and correctly related outlet temperatures can give you this performance.

High quality split-phase or capacitor motors (instead of less expensive shaded-pole motors) are used on all but the smallest Modine Unit Heaters. *This means lower power and motor maintenance costs!*

• UNIFORM HEATING COMFORT

Overheated outlet air is buoyant and rises quickly. Underheated air feels "chilly." Similarly, excessive air velocity causes drafts, while air delivered with insufficient velocity fails to reach the floor.

Because Modine outlet temperatures and velocities are *right*, and correctly related to each other, hot blasts and cold drafts are avoided. Floors are kept comfortably warm. Heating is uniform in all parts of the room even in coldest weather.

WHY MODINES LAST LONGER

Entire condenser is pure copper and copper alloy . . . for maximum resistance to electrolysis and corrosion. Tubes are red brass; fins and headers, copper.

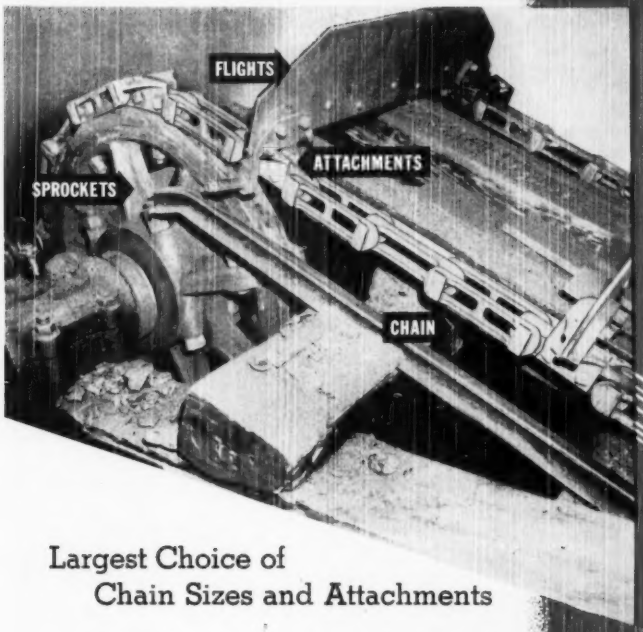
Differential expansion stresses are safely absorbed by bends in individual tubes and are not transmitted to tube-header joints to cause condenser fracture.

Fins are permanently bonded to tubes with metal. All condenser joints are brazed. There are no screwed or expanded joints to weaken condenser structure.

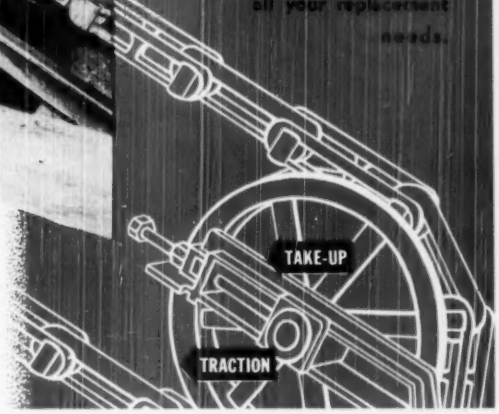
Parker-Bonderizing protects castings and sheet metal parts against formation and spread of rust. Anchors paint to steel. Prolongs original attractive finish.

Modine UNIT HEATERS U-1031

WILMOT HAS *Everything* for your CONVEYOR



As the originators of Rivetless chain conveyors, Wilmot Engineering Co. manufactures a complete line of parts for all sizes of coal, sludge and ash conveyors. This enables you to enjoy the advantages of placing single responsibility for supplying all your replacement needs.



Largest Choice of Chain Sizes and Attachments

By enabling you to depend on one source of supply for all your conveyor parts, Wilmot can solve both design and delivery problems for you, and thus prevent "down" time. As shown in our new 280-page catalog, Wilmot supplies the widest selection of rivetless chain sizes and attachments available.

Wilmot Stocks All Specified Sizes of "Rivetless" Chain; for 3,000 to 130,000 lb. Loads

We stock, for prompt shipment in any quantity, all sizes of Keystone rivetless chain in pitches from 3" to 10½" and working loads from 3,000 to 130,000 lbs.: of drop-forged EEE alloy steel, normalized or heat-treated; or alloy steels 3140 and 3240, heat-treated. In addition to the largest selection of attachments, Wilmot also has, or will design, everything for your coal, sludge or ash conveyors: cast iron or steel flights, sprockets, traction wheels, take-ups, shafting, bearings, casings, trough and all other needed parts,

Send for
NEW 280-PAGE BOOK ON CHAINS
Conveyors, Elevators

WILMOT ENGINEERING CO.

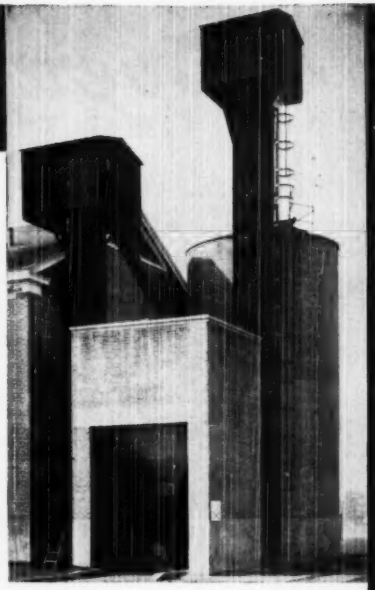
HAZLETON, PA.
Plant: WHITE HAVEN, PA.

Wilmot Coal Preparation Equipment: Hydrotators • Hydrotator-Classifiers • Hydro-Separators • Simplex Jigs Crushing Rolls • Sizing Shakers • Bucket Elevators • Conveyors • Car Hauls • Keystone Rivetless Chain, etc.

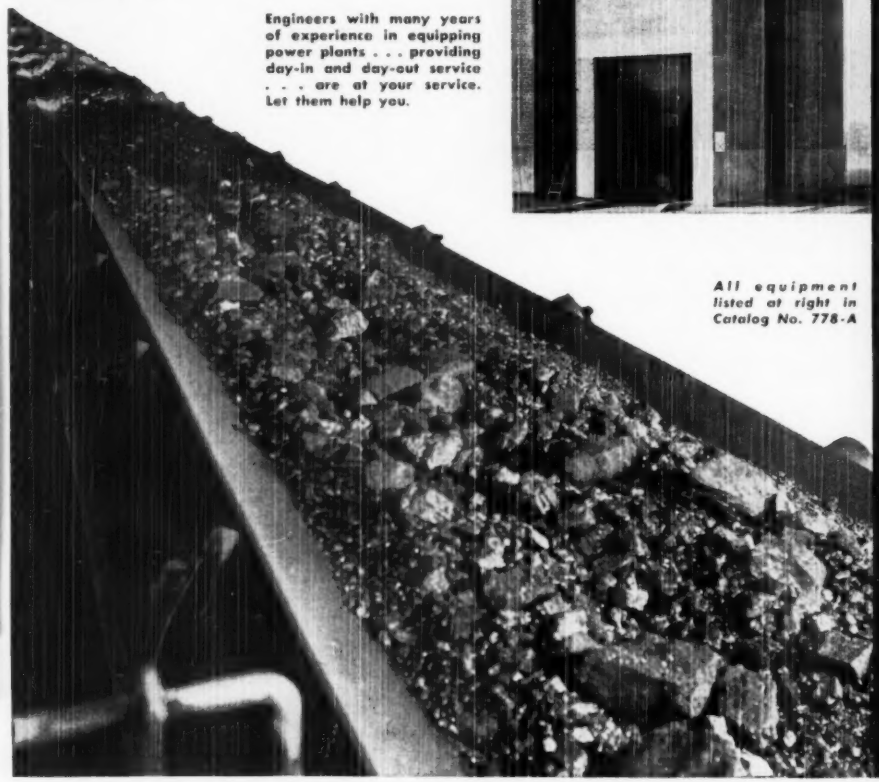
WILMOT BUILDS BETTER BREAKERS

Dependability
First Consideration

Coal and ashes handling machinery must be right. Failure especially during peak-load periods can be just as disastrous as the failure of the power generating equipment. Besides giving remarkably low cost per ton of coal handled, Jeffrey equipment has been safeguarding many plants for years. There is an efficient system for every type and size of plant.



Engineers with many years of experience in equipping power plants . . . providing day-in and day-out service . . . are at your service. Let them help you.



All equipment listed at right in Catalog No. 778-A

- Apron Feeders
- Ashes Handling Systems
- Bin Valves
- Belt Conveyors
- Belt Idlers
- Bucket Elevators
- Chains
- Car Pullers
- Crushers
- Drag Chain Conveyors
- Drive Arrangements
- Pivoted Bucket Conveyors
- Silo Storage Systems
- Skip Hoists
- Scraper Conveyors
- Sprockets
- Transmission Machinery
- Track Hoppers
- Weigh Larries
- V-Bucket Conveyors

THE JEFFREY MANUFACTURING COMPANY

Established 1877

932 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

JM

Baltimore 2 · Birmingham 3 · Boston 16 · Buffalo 2 · Chicago 1 · Cincinnati 2 · Cleveland 13 · Denver 2 · Detroit 13 · Harlan · Houston 5 · Huntington 19 · Jacksonville 5 · Milwaukee 2 · New York 7 · Philadelphia 3 · Pittsburgh 22 · St. Louis 1 · Salt Lake City 1 · Scranton 3

JEFFREY MFG. CO., LTD., Head Office and Works, MONTREAL

All These Were Once

DUST COLLECTION PROBLEMS, TOO

48 Carbon Black Plants

203 Metallurgical Installations

205 Acid Plants

40 Paper Mills

270 Detarring Installations

216 Power Stations

73 Steel Plants

99 Oil Refineries and Miscellaneous Installations

Your electrical precipitator installation will be individually engineered...and based on the Research Corporation's *experience* graphically shown by that towering pile of thousands of blue prints.

This knowledge is a valuable asset that will help Research engineers to "tailor-make" your Cottrell installation. For example, they can more quickly determine the right answers to such variables as the size, shape and type of both discharge and collecting electrodes, their relative spacing, flue arrangements and many other factors. At Research you can count on *profitable solutions to individual problems.*

In hundreds of power plants today, Research Corporation Cottrells are collecting 90% to over 99% of fly ash from pulverized fuel boilers. Write for your free copy of an informative booklet giving valuable data on these installations.

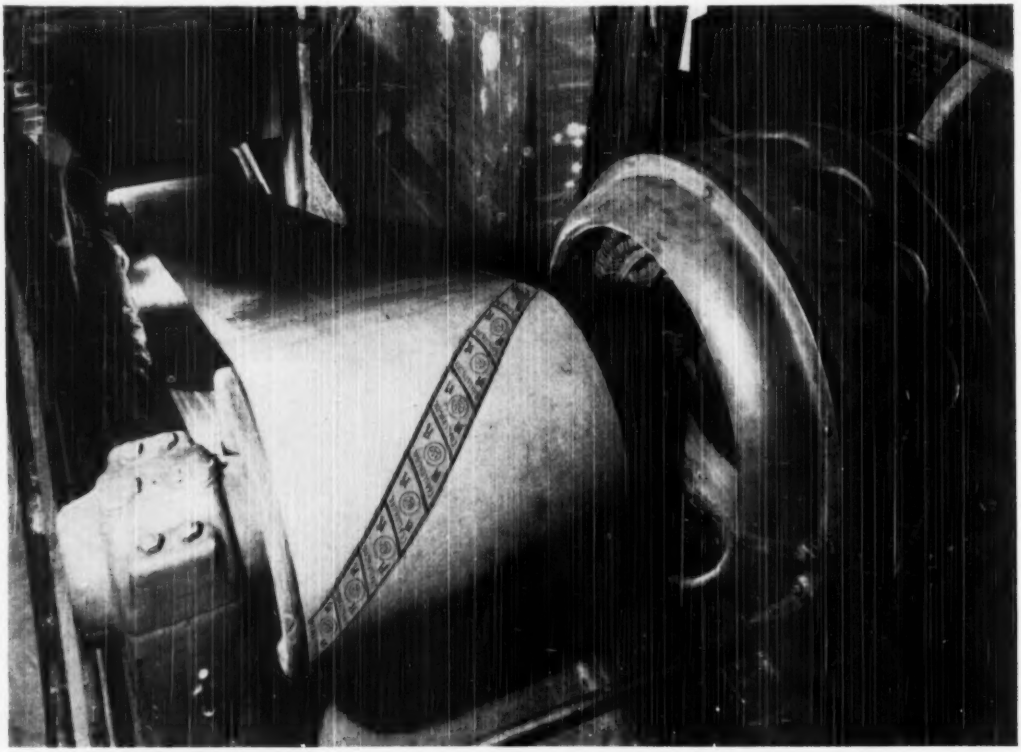
RC-116

Typical One Day Collections:

250 TONS OF FLY ASH • 6 TONS OF SODA SALTS AT A PAPER MILL • 25 TONS OF SODIUM SULPHATE AT A KRAFT MILL • 6 TONS OF BLAST FURNACE DUST

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois



for really efficient power transmission . . . it's Republic Rubber's *Challenger* Belting

No mistake about it. When it's a question of power delivery, the answer is Republic's Challenger Transmission Belting — the top performer of them all!

Challenger has been designed to handle your most difficult job. It's a flexible pre-stretched belt made of heavy, hard-woven, rubber-impregnated fabric for maximum service life. Challenger is an exceptional belt, being adaptable for long satisfactory service on heavy industrial drives subject to shocks and stresses, and also for drives operating at high speeds over small pulleys.

Challenger Belting is free from fastener trouble, and both top and bottom surfaces have special non-slip friction for better pulley traction. The edges are sealed against moisture, fumes and other deteriorating factors. Challenger is also fabricated with heat-resisting compounds for special operating conditions.

Standard plies and widths are available in roll lengths or tailor-made to specified endless lengths. Consult your nearby Republic Distributor today about your particular needs.

Remember, Republic Rubber has been *the* specialist in the mechanical rubber goods field for more than 48 years.

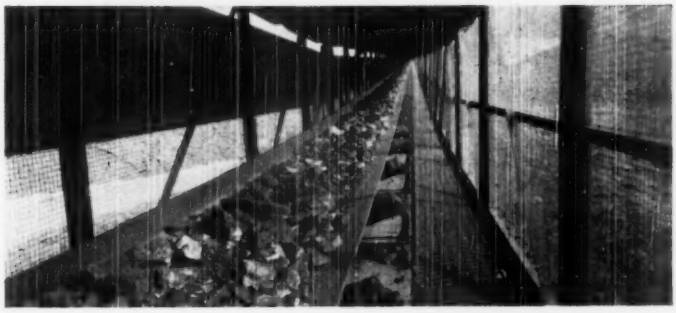
Pioneers in the use of COLD RUBBER

REPUBLIC RUBBER DIVISION
LEE RUBBER & TIRE CORPORATION, YOUNGSTOWN, OHIO
Lee Deluxe Tires & Tubes • • Conshohocken, Pa.

MECHANICAL RUBBER GOODS BY
REPUBLIC RUBBER DIVISION

For heavy-duty conveyors . . .

IT'S TIMKEN . . .

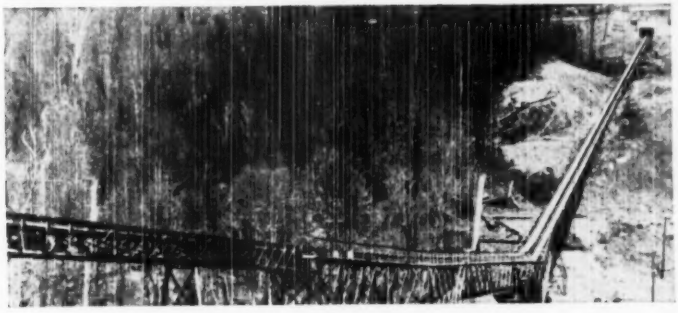


FOR over 25 years almost every heavy-duty conveyor — like most heavy duty equipment throughout industry — has relied on Timken® tapered roller bearings for long life and trouble-free performance. For example, The Blue Diamond Coal Company installed this Stephens-Adamson belt conveyor with 476 Timken bearing equipped idlers in 1930 —and at last report they haven't had to replace a bearing yet!

AND TIMKEN . . .

TIMKEN bearings are first choice for tough conveyor jobs like this Jeffrey Belt Conveyor installation used for long-distance sand hauling. Timken bearings provide maximum capacity for radial and thrust loads in any combination. Idlers turn freely, belt wear is reduced to a minimum. Effective seals keep lubricant *in*, dirt and moisture out. Lubrication and maintenance time is negligible.

AND TIMKEN® AGAIN!

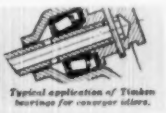


AND here's one of the latest Timken-equipped jobs — a 1,485 foot Robins conveyor at The Gauley Mountain Coal Company's Williams River Mine. It's another addition to the thousands of miles of heavy-duty conveyors that roll on Timken bearings. There's no other bearing with so much to offer, no other bearing so fully proved. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

Whenever the going's tough industry turns to

TIMKEN

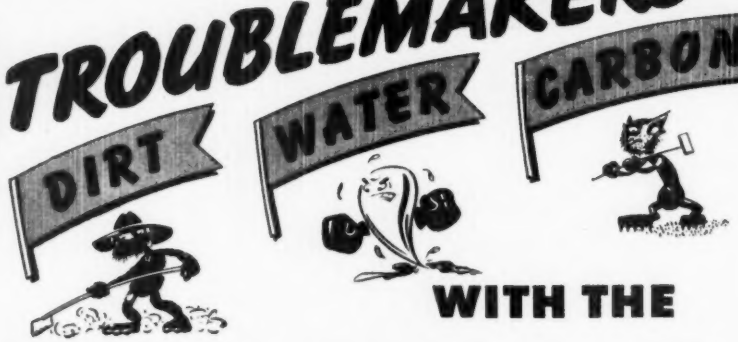
TAPERED ROLLER BEARINGS



Typical application of Timken bearings for conveyor idlers.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◯ AND THRUST ◯ LOADS OR ANY COMBINATION

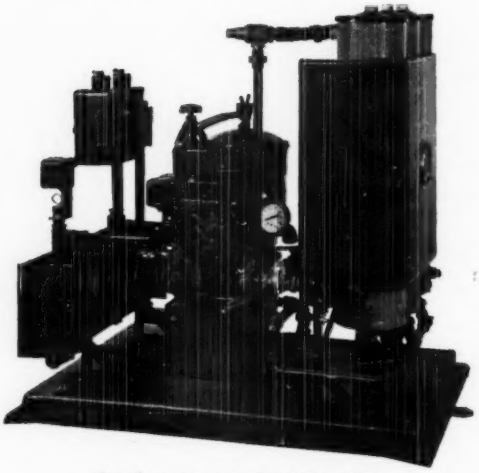
GET RID OF ALL 3 TROUBLEMAKERS...



WITH THE DE LAVAL "PURI-FILTER"

The De Laval "Puri-Filter" removes all three major contaminants of Diesel lubricating oil: dirt, water and colloidal carbon. The first two are separated from the oil by centrifugal force in the bowl of the De Laval Oil Purifier—the water being discharged continuously. The colloidal carbon is filtered out of the purified oil by the filters.

The De Laval "Puri-Filter" combines the De Laval "Uni-Matic" Oil Purifier and Fram "Filcron" Filters. Because the combination unit gets rid of all contaminants down to one micron in size, and likewise keeps the oil completely free of moisture, it is the most effective means ever devised for protecting Diesel engine bearings.



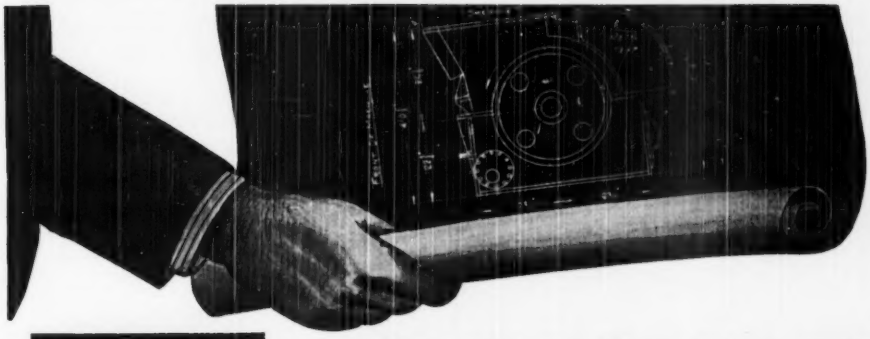
Crank cases remain clean when Diesel oil is "Puri-Filtered." Write for Bulletin DL-1, which gives additional details.

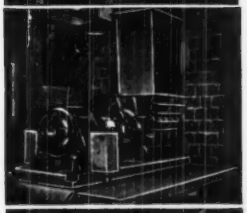
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

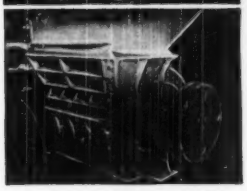
DE LAVAL *Oil Purifiers*

FOR DIESEL LUBRICATING OIL

YOUR FIRST STEP toward GREATER COMBUSTION EFFICIENCY...



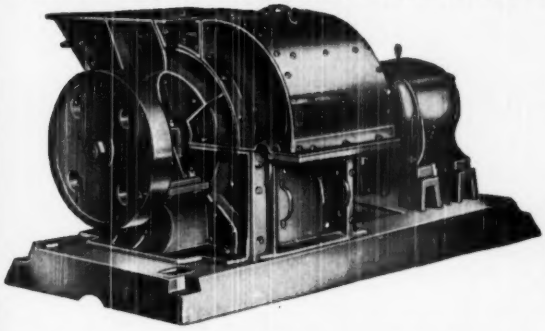




Custom-built for power plants, American Type "S" Crushers offer 9 different sizes, with capacities from 25 to 500 TPH.

AMERICAN *Rolling Ring* CRUSHERS

Uniform *High* Tonnage Reduction—at *Low* Operating Cost!



American Type "S" Rolling Ring Crusher, with heavy cast steel housing and sectional construction, secured at dust-tight, machined joints with coupling bolts for easy access to crushing chamber.

To hit highest operating efficiency, coal firing depends upon uniform sizing . . . one reason it pays to include American Crushers in your expansion and change-over plans. The exclusive shredder ring action of Americans—*through splitting instead of crushing coal*—gives a dependable uniform product with controlled fines—assures a loose, uniform firebed quickly responsive to sudden steam demands . . . without excessive ashpit drop or unnecessary CO_2.

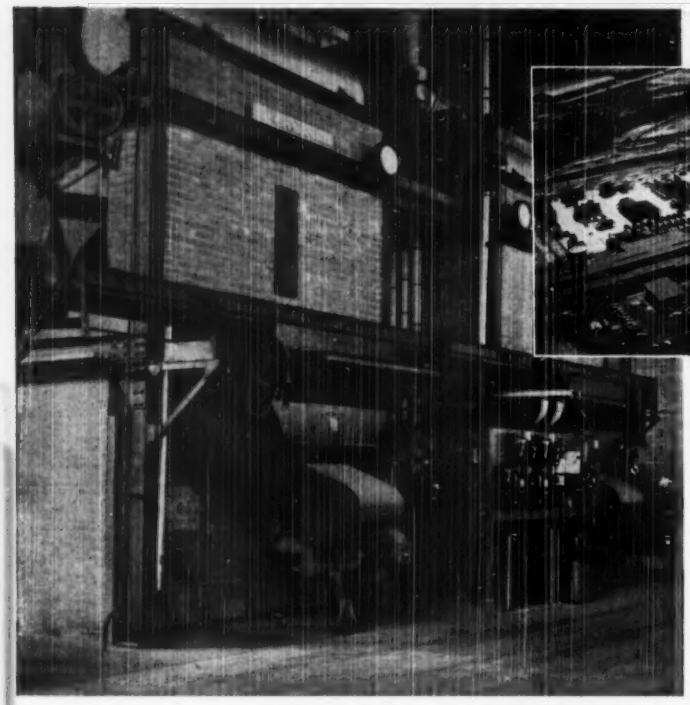
The minimum headroom requirements and independence from auxiliary crushing permit easy, economical installation of Americans without extensive alterations. Heavy cast steel housing and manganese steel shredder rings assure long, trouble-free service.

Send for your copy of "Crushing Coal for less than 1¢ per ton"

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.



THE EUCLID ROAD MACHINERY COMPANY, one of the foremost manufacturers of heavy equipment for moving earth, rock, coal and ore

TRIES OIL—SWITCHES BACK TO CANTON STOKERS

for Economy and Better Power Service . . .

When The Euclid Road Machinery Company built its modern Chardon Road plant in Cleveland, Ohio, two Canton Stokers were installed to fire the boilers of the power plant.

Later, one of the stokers was replaced by an oil burner but costs were too high and results not always satisfactory. Accordingly, when a new power plant was designed for greater economy and better results, Canton Stokers were placed back on the job.

Like hundreds of users of Canton Stokers for power and heating, Euclid finds by experience that Canton-Stoker-fired coal is the most economical and flexible fuel to meet the fluctuating demands of power and heating service. Moreover, Canton Stoker users enjoy the advantages of long, trouble-free service with almost negligible maintenance. Canton Stokers are so ruggedly built that *the driving mechanism is guaranteed for five years.*

Canton Stoker Field Sales Engineers will be pleased to help you find the economical answer to your power and heating problems — without obligation, of course. Write, phone or wire Canton Stoker Corporation, 714 Andrew Place S. W., Canton 1, Ohio.

CANADIAN LICENSEES: VOLCANO, LTD., MONTREAL, QUE.

CANTON STOKERS

DURAFLEX WORMFEED
for loads up to 175 H.P.

LO-SET RAMFEED
for loads up to 350 H.P.

VULCAN RAMFEED
for loads up to 800 H.P.

Also

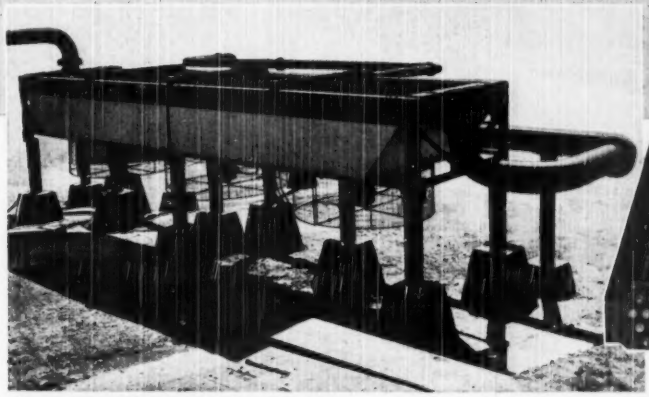
SYNCHRONIZED COMBUSTION CONTROL SYSTEMS
for all boilers

TURBO-AIRE JETS
for smoke abatement, firing efficiency

Water Piping
Water Pumps
Water Treatment
Water Disposal
Water Freeze-Up
Water Corrosion

All these water problems and expenses eliminated by FIN-FAN

THE AIR-COOLED EXCHANGER



Single Fin-Fan Exchanger installed on the ground.

G-R K-Fin Air-Cooled Section used in the Fin-Fan Exchanger.

FIN-FAN . . . the *Air-Cooled* Condenser or Cooler developed jointly by The Griscom-Russell Co. and Fluor Corporation Ltd., completely solves the cooling water problem . . . by *eliminating* the cooling water.

That's FIN-FAN benefit No. 1. FIN-FAN'S wide adaptability is its No. 2 benefit. These units are being used for cooling solutions, process liquids, lubricating oil, gear oil, quenching oil, petroleum fractions, jacket water, and compressed gases, and for condensing exhaust steam, hydrocarbon vapors, and refrigerating vapors. A single installation can be used for two or more cooling and condensing duties simultaneously.

And FIN-FAN has many additional advantages. It can be installed wherever convenient . . . within a building, on a roof, or on the ground. Its effectiveness is entirely independent of the direction or velocity of the wind. It can be operated by any available source of power. Its construction is particularly sturdy and durable, capable of withstanding high temperatures and pressures.

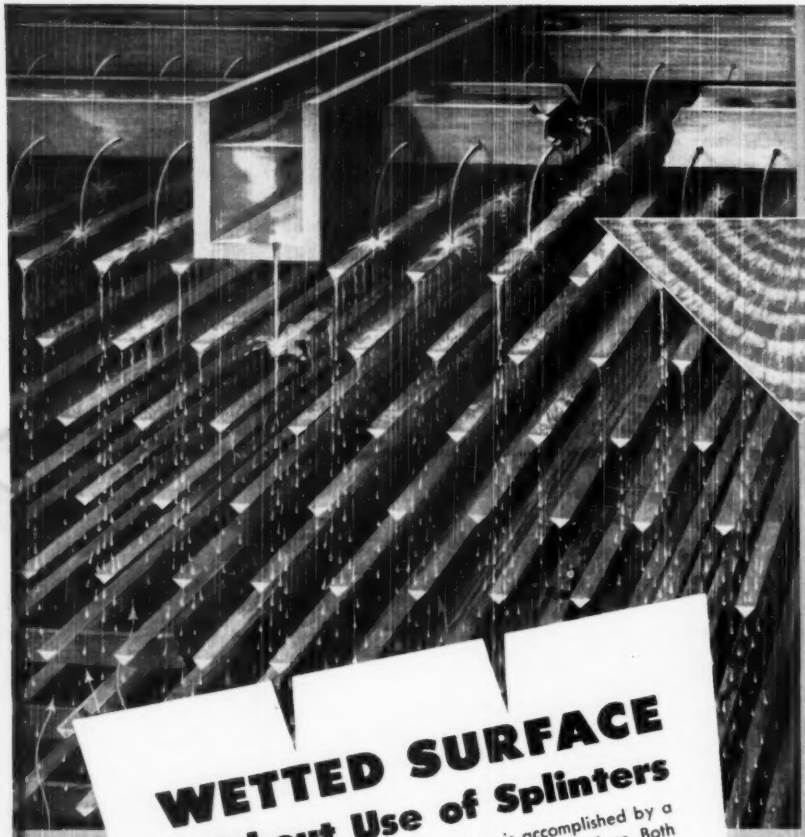
Write for Bulletin 1231 describing these many-purpose, many-benefit units in detail and for recommendations for your heat transfer needs.

THE GRISCOM-RUSSELL CO., 285 MADISON AVE., NEW YORK 17, N. Y.

GR-830

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS



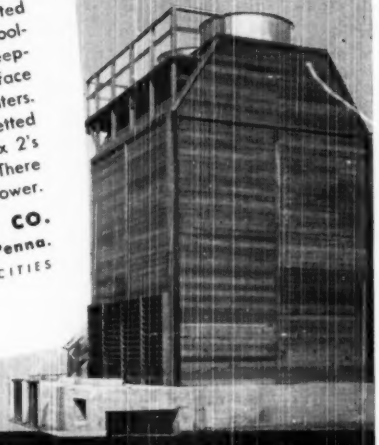
This triangle is the full scale cross section of C. H. Wheeler wood fill. The section modulus is large enough to provide maximum durability.

WETTED SURFACE
Without Use of Splinters

In all water cooling towers, the cooling is accomplished by a combination of wetted surface and water drop surface. Both are important. The wood fill serves two purposes—continuously reducing the size of the water drops to increase drop surface, and providing by its own area the necessary wetted surface. Both functions speed evaporation and hence, cooling. The correct size of wood fill does both, meanwhile keeping maintenance problems at a minimum. Wetted surface should not be attained by dividing lumber into splinters. The C. H. Wheeler Cooling Tower provides ample wetted surface, but with sufficiently rugged members (2 x 2's sawed diagonally) which last the life of the tower. There is no collapsing of the fill in a C. H. Wheeler Tower.

C. H. WHEELER MANUFACTURING CO.
1800 Sedgley Avenue, Philadelphia 32, Penna.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

SINCE 1903



C. H. Wheeler

STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION
OF PHILADELPHIA

A STACK THAT REALLY IMPROVES YOUR BOILER *Efficiency*

The Stack, fan and breeching are each only a *part* of an induced draft system. Separately built, they do not always provide the coordinated effort necessary for the most efficient draft that is possible.

Prat-Daniel Fan Stacks, however, offer an integrated induced draft system, combining the three elements of stack, breeching and I.D. fan, into one complete induced draft unit, each component designed to work with the other to produce the highest efficiency.

Prat-Daniel Fan Stacks are built to give your boiler a predetermined draft without excessive "safety factors" necessary with un-coordinated systems. They are completely fabricated and guaranteed by one responsible company . . . a company that has been designing and manufacturing draft-producing equipment for over a quarter of a century.

Write for the Prat-Daniel catalog on Fan Stacks.

Project and Sales Engineers

THE THERMIX CORPORATION

Greenwich, Conn.

Canadian Affiliates:

T. C. CHOWN, Ltd., 1440 St. Catherine St. W., Montreal 25, Quebec

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.

DESIGNERS AND MANUFACTURERS OF POWER PLANT EQUIPMENT FOR OVER 25 YEARS

Now you can have... perfected motion control for piping systems at pressures up to *1000 psi!

Illustrated is a 6" I.D. self restrained Flexoniflex unit designed to correct radial motion in a 700 psi. system. Other units are available to absorb the various other types of motion encountered in high pressure piping.

CMH Flexoniflex EXPANSION JOINTS

For power and process applications (and others, too) at working pressures up to *1000 psi., CMH offers perfected control of axial, offset and/or radial motion with Flexoniflex Joints. Whether the motion results from expansion and contraction, vibration, or most any other cause, CMH Flexoniflex Joints are the answer. Made by revolutionary methods in a variety of styles and tested and proved in the laboratory and the field, CMH Flexoniflex Joints open a complete new phase of high pressure piping.

Standard Flexoniflex units consist of a stainless steel pressure carrier, single or multiple ply, lined or unlined, with integral reinforcing rings. They may be used at temperatures from sub-zero to 1400° F. (higher with special materials).

Whatever your high pressure piping problems, CMH engineers will welcome the opportunity to make specific recommendations as to motion control. Just send an outline of your requirements.

**1000 psi. is a nominal pressure limitation. Flexoniflex units have been and will be designed and made for pressures well in excess of this.*

CMH—ONE dependable source for every flexible metal hose requirement

• CMH manufactures all standard types of flexible metal hose, both convoluted and corrugated, in a variety of metals; expansion joints for piping systems; stainless steel and brass bellows; various conduits and special assemblies of these components.

CHICAGO METAL HOSE CORPORATION

Leaders in the Science of Flexonics
1301 S. Third Avenue
MAYWOOD, ILLINOIS
Plants at Maywood, Elgin and Rock Falls, Illinois
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ontario

FLEXON . . . . . identifies CMH products which have served industry for more than 47 years

Oil in steam condensate reduced to less than .25 p.p.m. with the new . . .

SPARKLER PROCESS

For the first time oil can now be easily and cheaply removed from return steam condensate down to the remarkably low point of .25 p.p.m.; under favorable conditions even as low as .1 p.p.m., and without loss of heat or water softening values.

The average skimming or trapping method of oil removal leaves 12 to 20 p.p.m. of emulsified oil in the water. The better oil absorbent methods now widely used succeed in getting the residual oil down to 3 to 5 p.p.m.

The new Sparkler process, a much improved method based on the oil absorbent principle, reduces the residual oil to the remarkably low point of .25 p.p.m. with capacity for any required flow rate, and without loss of heat or water softening values.

The engineering details of this new process will be very interesting to any power plant operator who is having difficulty with oil removal from return steam condensate.

Write Mr. K. L. Carr, Sparkler Mfg. Co., Mundelein, Ill. Give details of your problem. Our engineers will personally supervise the installation of this new process in your plant to insure efficient and satisfactory operation.

Filters used in one installation of this process that provide a flow rate of 200 gallons per minute.

SPARKLER MANUFACTURING CO.

MUNDELEIN, ILL.

Makers of industrial horizontal plate filters for over a quarter of a century.

Operating Cost Savings

ENGINEERED INTO PIPING BY NAVCO

Careful and expert preliminary engineering work by Navco Engineers, in addition to employing the most modern fabricating and erection methods, are your guarantee of operating savings.

Consult Navco for just a Pipe Bend, or a complete Piping System.

- ★ Assured Safety
- ★ Efficient Operation
- ★ Minimum Fuel Costs
- ★ Low Maintenance
- ★ Long Trouble-Free Life

NAVCO

NAVCO PIPING

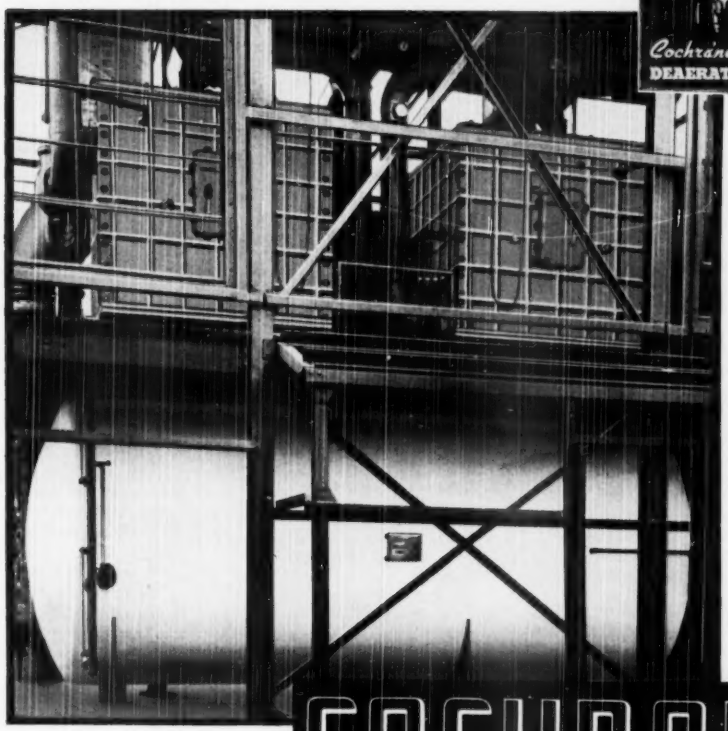
NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

Two Problems SPACE and FLEXIBILITY Solved by Cochrane Design

COCHRANE CORPORATION 87 YEARS OF SERVICE 1863 - 1950

TYPICAL of the ability of Cochrane engineering to overcome space limitations, is this installation serving a large New England public utility. The Cochrane Deaerator is a 900,000 lb./hr. unit providing oxygen-free feed water for 100% boiler make-up. Space for the installation was extremely limited considering the large capacity required. However, the problem was solved with a Cochrane Deaerator of ribbed cast iron with caulked joints, virtually custom tailored to fit the job. Another interesting fact about this particular installation is the use of the double heater tops on a single rolled plate storage tank, so piped that one can be isolated while the other continues in operation. Years of experience with unusual installation problems has given Cochrane the "know how" to fit thoroughly efficient, correct-capacity deaerating equipment into very limited space. Cochrane Deaerators are made in a wide variety of standard sizes and types, as well as special designs for plants with unusual space requirements. Cochrane Publication 3005 illustrates many interesting applications of Cochrane Deaerators, and gives complete details on their operation. Your copy may be had by writing to Cochrane Corporation, 3106 N. 17th Street, Philadelphia 32, Pa. In Canada, Canadian General Electric Company, Ltd., Toronto.



COCHRANE

DEAERATORS • HOT PROCESS SOFTENERS • FILTERS
ZEOLITE SOFTENERS • CONTINUOUS BLOWOFF SYSTEMS

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Chlorination for Controlling Marine Growth in Condenser Tubes

The problem of fouling is a complicated one and depends to a large extent upon the water characteristics. Warm waters contribute to the rapid growth of fouling agents which may consist of slime, algae, shellfish, a mossy substance similar to fine grass roots, fish, etc.

The importance of keeping tubes clean cannot be overemphasized. Manual, mechanical cleaning with live steam may be necessary in order to kill the larger organisms. Scrubbing with a brush and fresh water as well as steam and air lancing from the discharge side are often used. Periodic overheating above maximum growth environment temperatures are also sometimes effective.

Removing Slime

As mentioned in the previous issue of the Copper Alloy Bulletin, slime which builds up inside of the condenser tubes may lead to serious loss in heat transfer and is often responsible for accelerated corrosion. For these reasons liquefied chlorine is widely used for daily removal of slime. This practice is preferable to waiting until the slime accumulation becomes a problem.

Due to the corrosive action of chlorine solution on metals, excessive concentrations which may seriously damage condenser tubes should be avoided. Special automatic equipment is available for controlling the addition of chlorine to the circulating water.

Chlorination Procedure

Chlorination is most economically carried out with the unit operating at reduced load. Then the circulating water pump can be set at low speed and its discharge valve only partially opened (¼ or less). Liquid chlorine is then automatically fed into the stream of circulating water at a rate sufficiently to maintain a residual chlorine content of from 1 to 15 parts per million at the outlet of the condenser. The amount of chlorine needed to maintain a given residual varies according to the water on any given day or hour. With tidal waters this varies with the tide and the season of the year. The popular practice is to feed the chlorine into the circulating water on the inlet side of the circulating water pump for a period of about 30 minutes every twenty-four hours. Some operators prefer a 15-minute chlorination every eight to twelve hours. Such periods are established through experience as being effective for killing the slime which has accumulated between chlorination treatments.

After chlorination the discharge valve is usually opened wide and the circulating pump increased to high speed in order to rinse out the chlorine and dead slime.

Siphon Method

A difference in the elevation of the water level in the discharge tunnel as compared with the intake tunnel makes it convenient to chlorinate by a siphon method when the condenser is or is not in service. This is a very economical method of chlorination since the flow of water can be held at a very low rate.

When the condenser is in service, the unit must be operating at reduced load. Where the condenser is of the split type, it is possible to carry an appreciable load with one-half of the condenser operating in a normal manner, and to chlorinate the other half after the circulating pump on that side has been stopped. When circulation is definitely established by proper working of the siphon (in some plants the direction of flow will depend on the differences in elevation between the two tunnels), the chlorinator is put into operation and the chlorine fed into the intake pipe or tail pipe, depending upon the direction of water flow, for about half an hour. It is advisable to have several or more points of chlorine injection into the pipe in order to obtain the maximum mixing of the chlorine with the circulating water. At the end of this period the circulating water pump is started and the condenser rinsed out.

The effectiveness of the cleaning operation is determined by examining the tubes to determine their cleanliness. In some stations where chlorination has been carried out for years, smooth, thin, light brown, lacquer-like films form on the tube surface, and the tubes are clean along their entire length. Obviously, this is a desirable situation from a heat transfer standpoint and shows that no corrosion is occurring on the tube surface. It has also been reported that more sanitary water boxes result from chlorination.

The next issue will deal with Chemical Cleaning Methods to remove scales.

For technical information on condenser and heat exchanger alloys, write for our "Condenser Tube Manual" and contact our nearest Sales Office.

Back Issues of The Copper Alloy Bulletin

A limited number of back issues are available for those who do not have a complete set. If you or anyone else in your organization is not receiving the Bulletin regularly by mail, write us and we will gladly send it to you.

Also, it is always gratifying to hear from our readers regarding their problems or favorite subjects.

Write:

Editor of the Copper Alloy Bulletin, Marine and Power Edition, Bridgeport Brass Co., Bridgeport 2, Conn.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

For Noise Reduction

Snub the Slug and Stop the Noise

On Engine Exhausts and Compressor Intakes . . . Consult Burgess-Manning Engineers

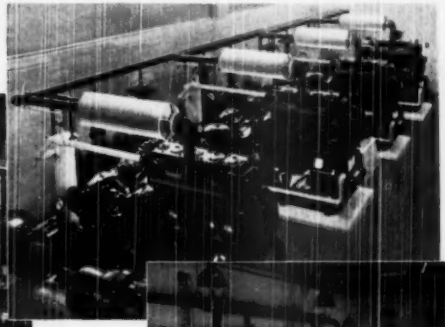
Compressors, blowers, Diesel and other internal combustion engines can be operated anywhere . . . without noise disturbance . . . when you equip them with Burgess-Manning Snubbers. They can also be used to control gas surging and the harmful vibration of machinery and piping produced by such pulsations. Snubbers prevent noise by smoothing the intake air and dissipating the energy in the exhaust gas slugs, providing quiet operation without affecting performance.

For solution of your noise problems, consult the Burgess-Manning engineers.

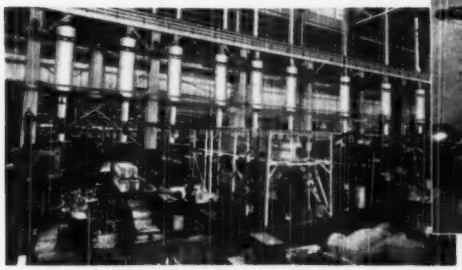
BURGESS-MANNING COMPANY
LIBERTYVILLE, ILLINOIS

INDUSTRIAL

Factories, test stands, hotels

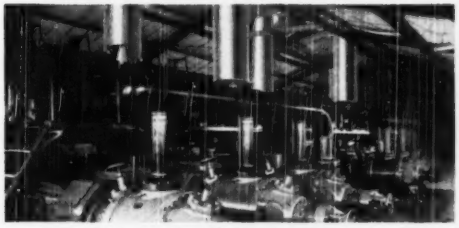


Pumping plant. Four Burgess-Manning Exhaust Snubbers employed.



Engine test stand. Ten Burgess-Manning Snubbers installed.

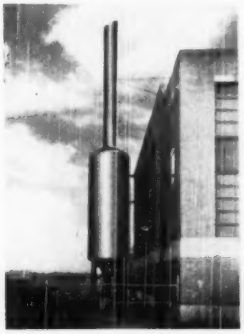
Compressed air system installation



Gas storage installation. Four Burgess-Manning Snubbers employed.

UTILITIES

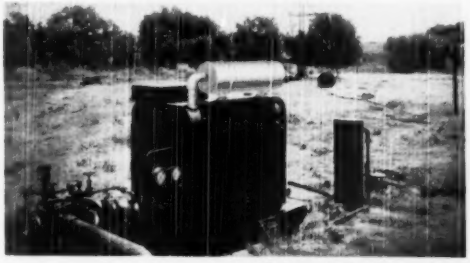
Power Plants, Water Systems



Electric power plant equipped with Burgess-Manning Snubbers.

OIL FIELD

Drilling, Pumping, Recycling, Refineries



Burgess-Manning Snubber on pipe line gathering engine.

A QUIET SPOT FOR TELEPHONING

Burgess-Manning Acousti-Booth

4 GOOD ANGLES

ON INCREASED OPERATING EFFICIENCY

ONE ANGLE you're vitally interested in is operating your power plant at top efficiency. And these typical Taylor Industrial Thermometers are built to give fast, accurate, dependable indications of all temperatures within minus 40 to plus 950°F, or equivalent Centigrade. They dependably verify the accuracy of other mechanical thermometers. What's more, they have the exclusive 3-times-easier-to-read BINOC tube that *actually invites* frequent reading, along with extra-bold black numerals and graduations against a white background. The thermometers shown are only a few of a wide variety of Taylor Industrial Thermometers—ready to give you long-lasting, satisfactory service. For full details write for Catalog E today! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

...Digging for facts

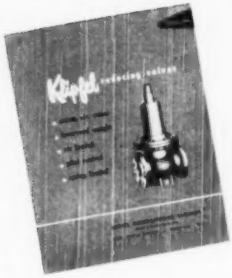
ON AUTOMATIC REGULATING VALVES?

YOU'LL FIND THESE KLIPFEL BULLETINS PRACTICAL, FACTUAL AND USEFUL!

Klipfel engineers have put a lot of experience and research into these bulletins to make them useful to you . . . the man who uses or specifies automatic regulating valves. Each bulletin covers such points as: the advantages and limitations of different valve constructions; selecting the proper type valve for given operating conditions; determining the most effective and economic size valve for the job.

In short, Klipfel engineers have prepared these bulletins to assist you in selecting the type and size valve best suited to your needs.

Write Dept. BC-1 for any bulletins you wish. We'll gladly send them to you.



KLIPFEL REDUCING VALVES
for steam, air and water . . . in lever and weight, air loaded, pilot control and spring loaded types; descriptions, illustrations and complete selection data in Bulletin 148.

KLIPFEL FLOAT VALVES
Single and double seated types with direct action or pilot control for remote location. Types shown include quick-acting valves; all are available in angle and globe patterns. Bulletin 349.

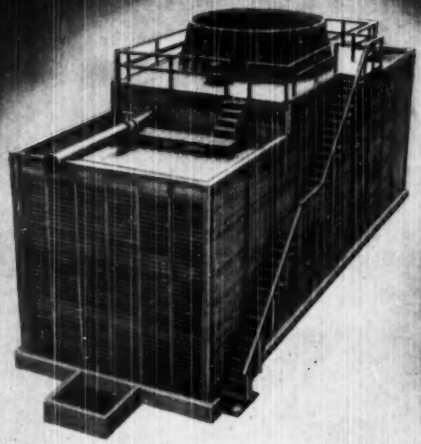
KLIPFEL THERMOSTATIC VALVES
vapor pressure operated valves with spring or weight and lever loading. Valves are ball type, balanced cup and disc or balanced inner valves. Min. temp. 80°. Max. temp. 250°. Range limit of any instrument 40°.

KLIPFEL BACK PRESSURE AND RELIEF VALVES
for control of air, steam and water pressures at the valve inlet in various types for practically any service. Bulletin 648 gives complete details including dimensions and capacities.

Klipfel VALVES INCORPORATED

DIVISION OF HAMILTON - THOMAS CORPORATION, HAMILTON, OHIO

Specify MARLEY Double-Flow



FOR SAFE OPERATION AND MAINTENANCE

STAIRWAY . . . DOUBLE-FLOW towers are equipped with a stairway built at the enclosed endwall of the tower. This eliminates fog envelopment and ice formation on stairways or ladders built over louvered sections. Operators do not have to climb high, dangerous ladders.

HANDRAILS . . . stairway and wide, level fan deck are guarded with high handrails. At no time is the operator at the mercy of high, gusty winds or in danger of inadvertently falling off the tower.

OUTSIDE WALKWAY . . . a short stairway leads to a walkway over each distribution basin. Water level may easily be adjusted or the basin cleaned. Complete flexibility of operation or maintenance is a result without the usual risks and dangers involved.

INSIDE WALKWAYS . . . through the interior of the tower, walkways enable the operator to observe water breakup, condition of structure, and operating conditions of the tower. This can all be checked while the tower is in operation without danger to the operator.

WALLED FAN CYLINDERS . . . each fan is enclosed with a fan cylinder . . . high enough for safety, low enough for easy inspection. And, there is plenty of room between the cylinder and fan deck railing for free movement without risk.

Tower owners and operators know that MARLEY DOUBLE-FLOW towers are SAFE TOWERS . . . safe in any stage of operation or maintenance . . . safe in any weather.

That's why more and more Safety Engineers of America's great industries are recommending MARLEY DOUBLE-FLOW COOLING TOWERS.

Ask for a MARLEY Factory-Trained APPLICATION ENGINEER to tell you more about the MARLEY DOUBLE FLOW Cooling Tower and its numerous SAFETY FEATURES. He'll be glad to help you solve YOUR [illegible] cooling problems. No [illegible] obligation.

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

Maximum

BOILER OUTPUT WITH LEAST AMOUNT OF FUEL

THROUGH

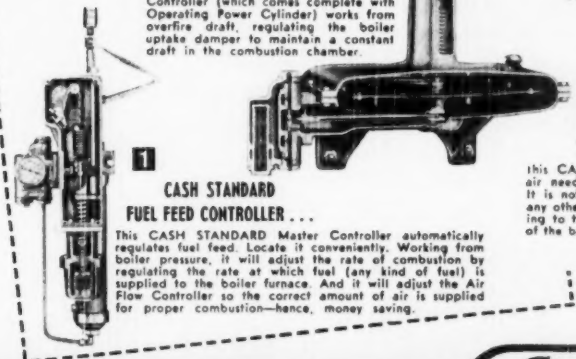
1. Automatic Regulation of Fuel Feed
2. Metered Air Needed for Combustion
3. A Constant Draft Maintained in the Combustion Chamber

Put this continuous automatic control to work for you in your boiler room. Get those important savings in smaller fuel bills, greater operating efficiency, and reduced maintenance. Increase the capacity of your present boiler.

The units shown here are available in a number of variations—combinations of these units can be made to give you complete automatic control with all of its benefits, whether you have a stoker, pulverizer, oil-burning or gas-firing equipment on your boilers. Size of your boiler or type make no difference.

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

• Bulletin No. 300 shows applications and gives details on CASH STANDARD Steam Plant Economy. Send for it.

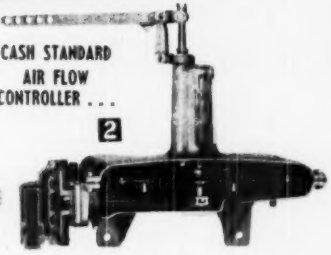


3 CASH STANDARD FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

1 CASH STANDARD FUEL FEED CONTROLLER . . .

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER . . . 2

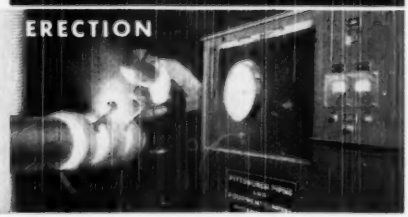
this CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not effected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

There's Only 1 RESPONSIBILITY

WHEN YOU TURN THE COMPLETE POWER PIPING JOB OVER TO P. P. & E.



Simplify responsibility on your next power piping installation—entrust the complete job to P.P.&E. These are a few of the advantages:

- Far less detail work for you.
- Correct interpretation of blueprints.
- Efficient detailing of shopwork for best coordination with field requirements.
- Maximum amount of system prefabricated, stress-relieved, model tested, as well as tested under ideal shop conditions.
- Field erection supervised by specially-trained personnel with a minimum of waste motion.

All these responsibilities—and many others—are made into one . . . *ours* . . . when the *complete* high pressure piping contract is turned over to us. Consult our nearest representative for futher information.

Pittsburgh Piping AND EQUIPMENT COMPANY

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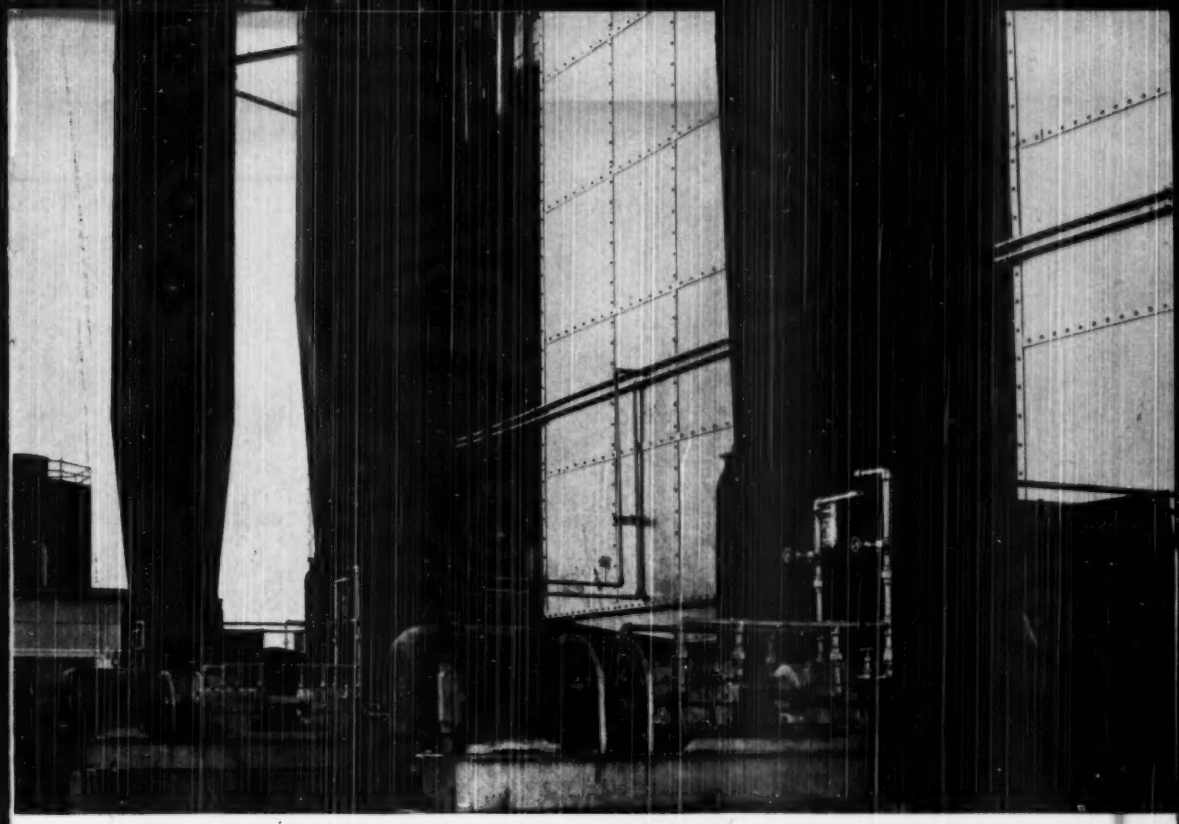


Husky Housings

SAVED INSTALLATION DOLLARS HERE!

—FURTHER ECONOMIES OFFERED TO YOU IN RUGGED "BUFFALO" INDUCED DRAFT FANS

● This "Buffalo" Induced Draft Fan installation at a prominent Natural Gas Company shows how easily stacks can be mounted on Buffalo fan outlets. The fan housings support the entire weight of the stacks in this economical outdoor installation.

This same rigid, heavy construction pays off in the long, punishing draft job, too. "Buffalo" Induced Draft Fans have extra-heavy housings and blades to stand the continual heat and erosion LONGER. Bearings and shafts are oversize—fully equal to continuous service demands. This means fewer timeouts (and timeouts cost money!). It means fewer repair bills. Yes, "Buffalo" Draft Fans are giving cheaper draft service everywhere because of this inbuilt extra endurance.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities

Why Not Look

INTO these rugged fans that always save you money in the LONG RUN? Just write for Bulletin 3190-B for all the engineering facts.

"Buffalo" FORCED AND INDUCED DRAFT FANS

The Cities Service Heat Prover Cuts Operating Costs...
Steps up Efficiency by Scientific Control of Combustion

IN ONE QUICK EXAMINATION the Cities Service Heat Prover can tell you how much efficiency you obtain from the fuel you burn. This remarkable instrument developed in the research laboratories of Cities Service accurately measures how much fuel is wasted unburned ... how much is wasted in uselessly heating excess air.

The instrument has been developed for use on industrial furnaces of every design regardless of the type of fuel used. It is also valuable when used for diesel and gasolene engine exhaust analysis.

There is no charge, no obligation; and no commitments made by you for this service. Write today for a demonstration.

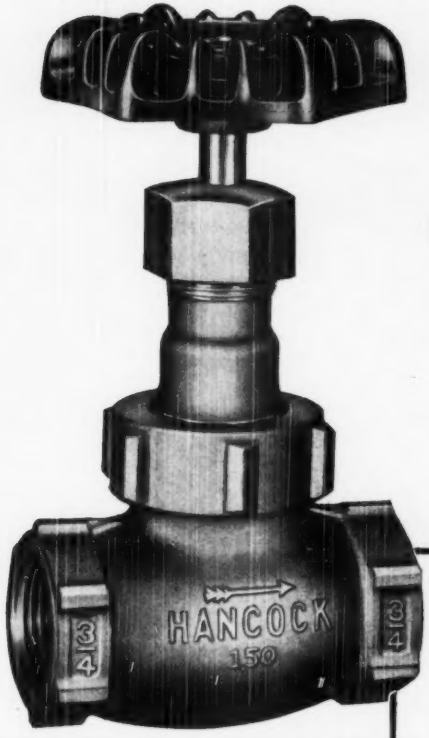
FREE—A fact-filled booklet entitled "Combustion Control for Industry." Write Cities Service Oil Company, Sixty Wall Tower, Room 540, New York 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

ANNOUNCING!

The New 150# Hancock "500 Brinell" Bronze Valve



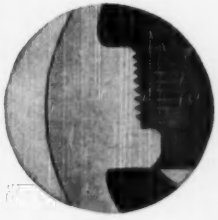
300# Valve Results at 150# Valve Prices!

"Super-Tough" is the word for the new 150# Hancock "500 Brinell" Bronze Valve. With a diaphragm construction equal to a 300# bronze valve, real strength and rigidity are built into this new bronze valve. Super-finished "500 Brinell" stainless steel seats and discs prevent leaks, cut maintenance cost to a minimum. Note the extra-rugged structure that means top ability to withstand expansions in piping systems, strains from installation and piping. Save money, increase efficiency, stop leaks. Install new 150# Hancock Bronze Valves.

For complete information, see your local distributor

Diaphragm construction of new 150# Hancock Bronze Valve 125% to 230% stronger than found in usual bronze valves.

Usual bronze valve diaphragm



Hancock diaphragm

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

HANCOCK *Valves*

1877 HANCOCK U.S.A.

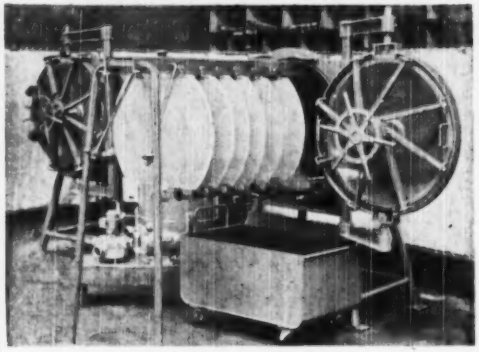
A PRODUCT OF

MANNING, MAXWELL & MOORE, INC.

WATERTOWN 72, MASSACHUSETTS

Makers of 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electronic Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties.

Emulsified or Free Oils Effectively Removed from Condensate with the BLACKBURN-SMITH REFINER



Outstanding Advantages

1. Breaks the tighest emulsion of oil in water
2. Reduces contamination to less than .1ppm.
3. Produces pure, clean condensate
4. Saves boiler tubes

Contaminated Condensate Formerly Wasted Can Now be Re-Used After Filtration Through the Refiner

Proved in service . . . saves heat units and fresh water . . . no back-washing . . . reduces boiler maintenance costs . . . improves boiler efficiency . . . simple and inexpensive to operate . . . requires little space.

Write for catalog. Engineering assistance gladly furnished.

Phone: Hoboken 3-4425 — **THE BLACKBURN-SMITH MFG. CO., INC.** — Phone: Rector 2-9360

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Subsidiary of Condenser Service & Engr. Co., Inc.

"LIQUIDS WORTH STORING ARE WORTH MEASURING" with a LIQUIDOMETER Tank Gauge

- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

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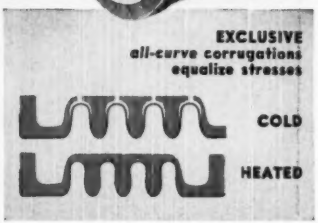
THE LIQUIDOMETER CORP.
39-16 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

ANOTHER REASON WHY Badger IS FIRST IN expansion joints



Because the flexing member is made from a single tube, Badger Expansion Joints are installed without packings. This feature alone means valuable savings in man hours . . . assures long service without attention.

And that's only *one* reason why you get top performance — *at lowest cost* — from Badger Corrugated Expansion Joints. Here are others:

- Flexible . . . joints easily compress and expand reducing thrust on adjacent fittings and equipment
- Compact . . . require no more space than regular flanged fittings
- Special forming methods . . . no danger of structure-weakening stresses
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- Directed flexing rings . . . to equalize stresses *between* and *within* corrugations

These features are important in any pipe line job — you can get them *all* only by specifying Badger Expansion Joints.

Write today for Bulletin 100 (self-equalizing type) or Bulletin 200 (non-equalizing type).

Badger

MANUFACTURING COMPANY

260 BENT ST. CAMBRIDGE 41, MASS.

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BUILT HEAVIER THAN COMMON PRACTICE, Clarage units — both large and small — are equal to the most severe conditions you can imagine in connection with air handling or conditioning installations.

SEE OUR CATALOG IN SWEET'S

EQUIPMENT for many of the biggest, most important air handling jobs in this country is furnished by Clarage. Through the years architects, engineers, contractors, users have come to rely on Clarage equipment for long time service at operating and upkeep costs surprisingly low. May we work with you on your next project in our field?

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Kalamazoo, Michigan

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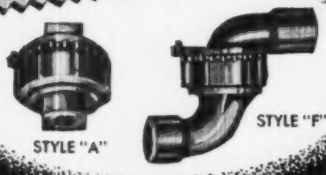
HEADQUARTERS for Air Handling and Conditioning

For Moving Pipe Lines
Safe • Dependable
FLEXO JOINTS



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PISTON VALVES

A MOST POSITIVE CLOSURE PRINCIPLE

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P-18

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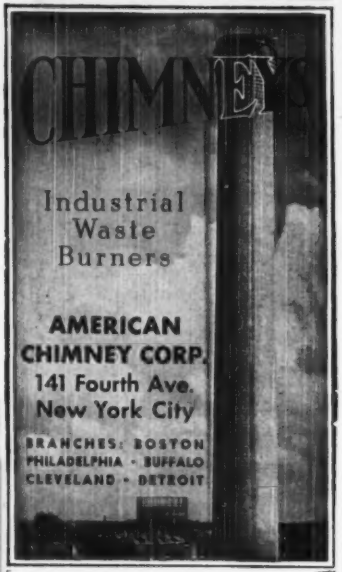

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SINCE 1905

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For the *practical* facts about pipe welding fittings go to the *practical* men...the welding foreman; the pipe fitter foreman; the construction superintendent... who have used all kinds and know the field.

They will tell you that the job moves faster and costs stay down when WeldELLS and other Taylor Forge fittings are used

...because of the precision quarter markings, the sized end tangents, the accurate machine tool bevels and lands.

They will tell you that the job maintains momentum easier, smoother

...because of the completeness of the line and better identification markings.

They can tell you...at least, design men will...that the *finished* job is better

...because it is done with fittings that are engineered down to the last detail to meet all requirements of *every job.*

Yes, "WeldELLS have everything"...to make it *easier ...better.* Coupon brings lots of facts.

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Please send a copy of your new welding fittings and forged steel flange catalog 484

Name_____

Position_____

Company _____

Street Address_____

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INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of rate, payable in advance.

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30-35, college graduate to start as assistant to Combustion Engineer with well established manufacturer. Should have experience in coal burning boiler work. Opportunity to broaden himself by periodic travel, participation in technical meetings, etc. Excellent opportunity —salary $5.-$6,000.00.

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Nationally known power equipment manufacturer offers unusual opportunity for graduate engineer with substantial sales experience in rotating machinery. Position requires background in industrial and municipal contacts. Development of new and potentially excellent territories in south and midwest. Forward detailed resume of experience indicating past sales record, as well as earnings expectancy. All replies will be held in strict confidence.

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CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

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ESTIMATOR—QUALIFIED to estimate plumbing, heating and power plant jobs running into several million dollars. Prefer mechanical engineering graduate with field experience. Permanent position for the right man with salary and bonus commensurate with qualifications and results. Submit experience record and educational background for review and if interesting to us, personal interview at our expense will be arranged. Reply immediately to Virginia Engineering Company, Inc., Newport News, Virginia, Attention: A. M. Miller.

Engineers — Executives — Technical Men
Salaried Positions, $4,000 to $30,000.

This Confidential service for men who desire a new connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details.

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MECHANICAL SUPERINTENDENT—Qualified to supervise installation of plumbing, heating and power plant jobs running over one million dollars, also mechanical equipment and piping installations in sewage disposal and water treatment plants. Mechanical engineering graduate with some office experience in estimating preferable, but not essential. Permanent position for properly qualified man with salary and bonus in line with qualifications and results. Submit experience record and educational background for review and if interesting to us, personal interview at our expense will be arranged. Reply immediately to Virginia Engineering Company, Inc., Newport News, Va., Attention: A. M. Miller.

WANTED: SUPERINTENDENT electric power plant, permanent position, must be experienced licensed steam engineer. Salary $4800. Housing, heat, light furnished. State experience, vital statistics, references. Apply airmail President University of Alaska, College, Alaska.

LEADING WATER Treatment Co. expanding engineering and technical sales divisions, requires (a) technical sales and engineering representatives for east, southwest, midwest and west, (b) research chemist in internal water treating problems for eastern laboratory, (c) analytical chemist for special problems in an eastern water laboratory. P 1753, Power.

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SALARIED PERSONNEL $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Ira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

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MAINTENANCE SUPERVISOR or plant engineer. Age 36—married—3 years college experience—5 years marine engineer on turbo-electric ships. One year as chief engineer 10,000 kw plant. Thorough knowledge of boilers, turbines, pumps, piping systems, cargo refrigeration plants, electric generators, motors and switchboards. Seven (7) years construction superintendent with general contractors in heavy construction and factory maintenance. Broad experience in concrete structures and public utility construction. Energetic-reliable. Prefer West or Northwest location. Address PW-1223, Power.

POWER PLANT Operating Engineer. Graduate M.E. 10 years experience modern high pressure utility and industrial power plants. Desires position active supervision of operations steam electric station. PW-1722, Power.

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HEMPHILL SEAL

it means equipment

- SELECTED BY EXPERTS
- REBUILT AND TESTED
- UNDER SUPERVISION OF
- HEMPHILL ELECTRICAL ENGINEERS
- GUARANTEED PERFORMANCE

TRANSFORMERS — 60 Cycle

QU.	KVA	MAKE	TYPE	PH.	VOLTAGES
1	1000	GE	Auto	3/2	4150 x 2406
1	1000	GE	Auto	3	3810Y-2300Y
1	500	Kuhl.	OISC	1	4600 x 2300V.
3	400	GE	H	1	6000 x 2250V.
1	300	Pitts.	ODSC	1	7800 x 440V.
3	300	GE	H	1	2400 x 120/240
1	200	Whse.	Auto	3/2	4150 x 2300
1	200	Pitts.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/2	4150 x 2400
1	150	GE	RS	1	2300 x 230
1	100	Pitts.		1	2750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
2	100	Whse.	SK	1	4400 x 220/440 Tape
2	100	Newark	Dry	3/2	440 x 220
3	100	GE Pyrn.	H	1	4160 x 220/440
3	100	GE	Auto	1	4150 x 2300
1	100	Amer.	OC	1	15000 x 2300
3	75	GE	H	1	2400 x 220/440
3	75	Whse.	SK	1	2400 x 440
7	50	Whse.	SK	1	13750 x 125/250
11	50	GE	H	1	13750 x 125/216
5	50	Whse. Inert.	S	1	4160 x 120/240
2	37½	GE	H	1	2400 x 120/240
2	37½	AC Dry	AD	1	450 x 120
1	37½	Amer.	RS	1	13800 x 220/440
1	37½	GE	H	1	13800 x 220/460
1	37½	Amer.	OISCID	1	13200 x 220/440
3	27½	GE	Dry	1	440 x 220/110
12	25	Whse.	Dry	1	440 x 220/110
1	25	Maloney	Oil	1	230/460 220/110
2	25	GE	H	1	11500 x 240/460
1	25	Maloney	Oil	1	2400 x 120/240
1	18	GE	K		17500 x 440

A.C. GENERATORS
3 Phase, 60 Cycle

QU.	KVA	MAKE	TYPE	VOLTS	SPEED
1	2500	Whse.		2300	720
1	625	GE	ATB	600	3600
1	375	AC		480	450
1	300	GE	ATB	600	600
1	200	AC		240	3600
1	200	Whse.		240	600
1	225	Whse.		550	514
1	125	GE	ATB	240	600
1	170	Whse.		2200	900
2	50	Whse.		220/440	900
3	44	Columbia		240	1200
1	31	Amer.		120/208	1200
1	18.75	Star		220/440	1800
1	12.5	Whse.		240	1200

D.C. MOTORS

QU.	HP	MAKE	TYPE	VOLTS	SPEED
1	125	GE	RC	230	1700
1	100	GE	LC	230	625

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

QU.	KW	MAKE	SPEED	DC	AC
1	1000	Whse.	720	275	2300/4150 Syn.
1	1000	GE	514	600	2300/4150 Syn.
1	500	GE	900	275	2300/4150 Syn.
1	400	GE	900	275	2300/4150 Syn.
1	300	GE	1200	250	2300 Syn.
2	150	GE	1200	125/ 250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	El. Mach.	1200	125	4150 Syn.
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	60	220/440 SC
1	50	Ridgeway	1200	550	220/440 SC
1	50	Whse.	900	250	220/440 SC
2	40	El. Mach.	1750	125	440 SC
1	25	Ideal	1200	125	220/440 SC

OIL CIRCUIT BREAKERS

1—3000	A GE	15000V	3 pole	FK	130
1—3000	A GE	4500V	3 pole	FK	12
2—3000	A GE	600V	3 pole	K	25
1— 600	Whse.	15000V	3 pole	F	124
1— 600	Whse.	7500V	3 pole	F	124 A

SPECIAL DIESEL

1—300 KW De La Vergne Baldwin 6 cy, 4 cycle, 400 RPM, 125/250V.

SPECIAL

1—120 KW 150 KVA Ames Uniflow 16 x 16 220V, 3 ph, Non-Condensing.

NEW CONTROL

4—150 HP GE CR 7051 Sq. Cage Automatic 440V, 3 ph.

LARGE STOCK OF D.C. MOTORS AND GENERATORS, SWITCHBOARD AND CONTROL EQUIPMENT

A.C. MOTORS
3 Phase, 60 Cycle
Synchronous

QU.	HP	MAKE	TYPE	VOLTS	SPEED
4	200/100	Whse.		4150	720/360
1	200	El. Mach.		2300	360
1	200	GE	TS	440	257
1	185	GE	ATI	2300	720
1	150	GE	TS	220	1800
2	150	AC		2300	360
1	100	GE	ATI	2300	900
1	70	El. Mach.		2300	180
1	35	GE	ATI	2200	1200
1	20	Whse.		220	1800

SLIP RING

1	2500	GE	MT	6600	257
1	850	GE	MT	2300	720
1	150	GE	IM	440	450
1	100	GE	IM	440	400
1	75	GE	MT	220	1200 Vert.
1	75	GE	MT	440	900
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1300
1	40	GE	MT	2200	1200
1	40	GE	MT	220	900
1	40	GE	MT	2200	900
1	30	GE	M	220/440	1200

SQUIRREL CAGE

QU.	HP	MAKE	TYPE	VOLTS	SPEED
1	150	CW		2300	1200
1	125	GE	KF	2300	1800
1	125	US		440	1200 Vert
1	100	La	RY	440	1800
1	100	Whse.	CS	440	1800
1	75	GE	KF	220/440	1200
1	75	Ideal	AT	220/440	1300
1	60	Whse.	CS	2200	900 Vert
1	40	GE	KT	220	1300
1	40	Whse.	CS	220	900
1	40/30	Whse.	CS	440	575/435
1	35	Whse.	CS	2200	1200
1	35	GE	IK	550	600
1	30	GE	KT	220	600
1	25	GE	KT	220	1165
1	25	GE	KT	440	1200

JLHCo

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J.L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

Our 43rd Year

WAGNER

Quality and Service

"CERTIFIED REBUILT"

DEPENDABLE ELECTRICAL EQUIPMENT AT LOW COST

MOTORS . . . GENERATORS . . . M-G SETS

PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

250 KW Allis-Chalmers M-G Set,D.C. 120/240V. output, 353 H.P. Synch. Motor, 3/60/440V. 1200 RPM, A.C. & D.C. panels, late model.

M-G SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	Gen. Elec.*	2300 AC	250 DC
300	Allis Ch.*	230/440 AC	250 DC
250	Allis Ch.*	440 AC	120/240 DC
200	Ridgway*	2300/4000 AC	250 DC
150	Gen El.*	2300/4000 AC	250 DC
150	Whse.	230/440 AC	50 DC
105	Century b.b.	230/440 AC	70 DC
100	Allis Ch.*	230/440 AC	125/250 DC
100	Allis Ch.	2300 AC	250 DC
100	Gen. Elec.*	220/440 AC	125 DC
75	Star*b.b.	220/440 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
50	Whse.	230/440 AC	250 DC
50	Gen. Elec.	230/440 AC	125 DC
40	Northw'n Conv.	220 AC	230 DC
35	Gen. Elec.	220/440 AC	48 DC
33	Gen. Elec.	220/440 AC	180 cycle
30	Gen. Elec.	220/440 AC	250 DC
25	Gen. Elec.	220/440 AC	25 DC
20	Star b.b. (2)	220/440 AC	250 DC
15	Gen. Elec.	230/440 AC	125 DC
10	Allis Ch. (2)	230/440 AC	250 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
200	Reliance	1970T	230	575/750
150	Cr. Wheeler, b.b.	52H	230	1200
150	Cr. Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	450/600
100	Gen. Elec.	C	230	575/1000
100	Gen. Elec.	RC36	115	1150
75	Allis Ch.	E-149	230	600
75	Northw'n	K20	230	1750
75	Cr. Wh. New b.b.	CMC-HH	230	1150
60	Cr. Wh. b.b.	H	230	1150
50	Gen. Elec.	RC36	230	650
50	Gen. Elec. b.b.	CDM	115	1150
40/60	Whse. (2)	SK170	230	500/1000
40	Sprague dyna.	LC	230	750/2000
40	Gen. Elec.	CD113	230	850
40	Whse. (2)	SK130	230	950
35/50	Gen. Elec.	CD123	230	575/1150
35	Ideal	DV350	230	400/1200
30	Whse. (2)	SK93	230	1750
30	Whse.	S-7	115	900
30	Gen. Elec.	RC31B	230	1150
25	Sprague dyna.	LC	230	750/2000
25	Chand'son (4)	C13	115	850
25	Gen. Elec.	CD85	230	1750
20	Gen. Elec.	RF12	230	400/1600
20	Whse.	SK93	230	1150
20	Reliance	T	230	850
20	Gen. Elec.	CD85	230	1150
20	Whse.	SK130	230	600/1500
15	Whse. (3)	SK90	230	825
15	El. Dyn. b.b.	326	230	1750
15	El. Dyn. b.b.	158	230	800/1200
15	Whse. (2)	SK50L	230	1150
15	G.E. TEFC b.b.	CD83	230	1750

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	230	1200
105	Century b.b.	1800 amp.	70	1200
100	Gen. Elec.	RC17	115	1750
100	Gen. Elec.	G	230	1750
100	Allis Ch. 3 wire	MCW	120/240	1200
75	Cr. Wh. New b.b.	HH	250	1450
75	Allis Ch.	E	250	750
75	Gen. Elec. (2)	RC36	125	1200
50	Allis Ch.	E-147	250	450
40	Gen. Elec.	CD	250	1150
35	Northw'n.	K	125	1150
30	Elec. Prod.	BP	50	1150
30	Gen. Elec.	RC	250	1500
30	Whse.	SK9	250	1750
15	Star b.b.	SQ	240	1750

EXPLOSION PROOF MOTORS

from 1 to 30 H.P. . . . . std. speeds

A. C. MOTORS — 25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
150	Whse.	HF	440	500
150	Gen. Elec.	IK-16	440	750
80	Allis Ch.	ANY	440	750
80	G.E. int.	MTC5337	440	750
80	G.E.	I-K	440	750
50	Gen. Elec.	KT339	440	1500
40	Gen. Elec.	KT243	440	750
20	Gen. Elec.	KT327	440	750
15	Whse. TEFC	CS355	220/440	1500

A. C. GENERATORS - - 60 CYCLE

KVa	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
300	Gen. Elec.	AT84	240x480	720
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	240/480	600
187	Gen. Elec.	ATB	240/480	900
150	Gen. Elec. (2)	ATB	240/480	450
150	Gen. Elec.	ATB	240/480	900
125	Gen. Elec.	ATB	240/480	300
100	Gen. Elec.	ATB	240/480	900
100	Gen. Elec.	ATB	240/480	1200
56	Gen. Elec. (3)	ATB	240/480	1200
56	Gen. Elec.	ATB	240/480	900
31	Gen. Elec.	AT17536	240/480	1200
25	Whse. b.b.	1 ph.	120/240	900

A. C. MOTORS — SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	Allis Ch.	ANY	450
2—	300	Allis Ch. 2300V.	ANY	720
1—	300	G.E. 2200V.	I-M	1800
1—	300	Whse. 2200V.	CW	600
1—	250	Allis. Ch. 2300V.	ANY	514
1—	200	Gen. Elec.	I-M	360
1—	200	Gen. Elec.	I-M-17	600
1—	200	Gen. Elec.	IM-17A	450
1—	200	Allis Ch. 2300V.	ANY	720
1—	150	Gen. Elec. 2200V.	IM-16	600
1—	150	Whse.	MW	450
1—	150	G.E. 2200/4000V.	I-M	1200
1—	150	Allis Ch.	ANY	600
1—	100	Allis Ch.	AR 226D	900
1—	100	Allis Ch.	ANY	1800
1—	100	Allis Ch. b.b. NEW	ANY	600
1—	100	Allis Ch.	ANY	720
1—	100	Whse. int.	CI-756A	720
1—	100	Fair. Morse b.b.	HY	900
1—	75	Gen. Elec.	I-M-E13	1200
2—	75	Gen. Elec.	IM-14	720
1—	75	G.E. int. duty	MTC5342	900
1—	75	Ideal int.	AVE	1200
1—	75	Gen. Elec.	MT558	600
1—	75	Gen. Elec.	MT337	1800
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair. Morse	BV	720
1—	50	Gen. Elec. int.	ITC5013	600
1—	50	Whse. int.	CI	900
1—	50	Gen. Elec.	I-M	720
2—	40	Gen. Elec. int.	MTC 5526	900
1—	40	Gen. Elec.	MT346	900
1—	37	Gen. Elec. int.	ITC	600
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT346	600
2—	25	Gen. Elec.	MT332	900
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
2—	20	Gen. Elec. int.	MTC 5512	900
1—	20	Gen. Elec.	MT308	1800
12—	10	Reliance New b.b.	AW-324	1800

A. C. MOTORS — SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
600	Gen. Elec.	ATI	220/440	1800
300	Gen. Elec.	ATI	220/440	720
250	Ideal	2BC-M4	2300	450
230	G.E. 3 brg. .8 PF	ATI	220/440	900
200	G.E. .8 PF	ATI	220/440	900
150	Gen. Elec.	ATI	220/440	300
125	G.E. sphrf. .8 PF	TS954	220/440	1200
125	Gen. Elec.	ATI	220/440	900
100	American b.b.	YGH	220/440	900

A. C. MOTORS — SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	400	Whse. 2300V.	CS	1800
1—	250	Gen. Elec.	I-K	1200
1—	250	Louis Allis 2300V.	OGS	1800
1—	200	Reliance b.b. NEW	C8085	1800
1—	200	Allis Ch.	AN	1800
1—	150	Gen. Elec.	I-K-16	600
1—	150	Whse. 2200V.	C8771-1C	1800
1—	150	Reliance b.b. NEW	B8085	1200
1—	100	Gen. Elec.	IK-15	900
1—	125	Reliance b.b. NEW	C8085	1200
2—	125	Allis Ch. 2300V.	AN	1200
1—	125	Gen. Elec.	IK-16	450
1—	125	Cont. 2200V b.b.	SC	1800
1—	125	Gen. Elec.	KT339	3600
2—	125	Rel. TEFC NEW	B8085	1800
1—	100	Gen. Elec.	IK-14	900
1—	100	Gen. Elec.	I-K	1800
5—	100	Allis Ch. 2300V.	AR336	1200
1—	100	Reliance b.b. NEW	C8085	900
1—	100	Elec. Mashy.	b.b.	1200
1—	100	Rel. TEFC NEW	C8085	1200
1—	100	G.E. b.b. NEW	KS048	1800
1—	100	Cont. TEFC	NP583	1800
1—	100	Gen. Elec.	IK-15	720
3—	75	Gen. Elec.	IK	600
1—	75	Gen. Elec.	I-E14	720
1—	75	Reliance b.b. NEW	C8084	900
1—	75	Reliance TEFC NEW	C8084	1200
1—	75	Reliance b.b. NEW	C805	1800
1—	5	Gen. Elec.	KT329Y	3600
2—	75	Reliance b.b. NEW	C805	1200
1—	75	Gen. Elec.	KT347	1200
1—	60	Gen. Elec.	KT353	720
1—	60	Gen. Elec.	KT344	900
2—	60	Reliance b.b. NEW	B804	1800
2—	60	Rel. TEFC NEW	C805	1200
2—	60	Reliance b.b. NEW	C804	1200
2—	60	Whse. H.T.	CS504	1800
1—	60	Wagner b.b.	RP444	3600
1—	50	Whse. b.b. NEW	CS4055	1800
1—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
1—	50	Whse. hislip	WL507	900
2—	50	Whse. b.b.	CS504	1200
2—	40	Gen. Elec.	KT352	600
1—	40	Gen. Elec. b.b.	KP404S	3600
2—	40	Gen. Elec.	KT327	1800
1—	40	Al. Ch. 3 speed	ARX 900/600/450	
4—	40	Gen. Elec.	KT338	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Rel. TEFC NEW	C445	1200
2—	40	Gen. Elec.	KT332	1200
3—	38	Gen. Elec.	I-K	720
3—	30	Gen. Elec.	KT333	900
1—	30	Al. Ch. TEFC b.b.	ARZ445	900
2—	30	Howell b.b. 4 speed	SC	1800
2—	30	G.E. NEW b.b.	KS65	1800
2—	30	G.E. NEW hitorq.	KG365	1800
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec	KT336	720
1—	30	Wagner	22T3P	900
1—	30	Whse.	CS045	900
3—	30	Reliance b.b. NEW	C404	1200
3—	30	Reliance TEFC NEW	C444	1200
3—	25	Rel. TEFC NEW	C444	900
1—	25	Reliance b.b. NEW	C364	1800
3—	25	Reliance TEFC NEW	B365	1800
3—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
3—	25	Whse. NEW spl. b.b	CS343	1800
1—	25	Whse.	CS345	900
2—	25	Gen. Elec.	I-K	600
1—	20	Reliance b.b. NEW	C404	900
1—	20	G.E. TEFC b.b.	K404	1200
4—	20	Reliance b.b. NEW	C364	1800
3—	20	L.A. NEW exp. prf.	EX364	1800
1—	20	Whse. NEW b.b. sp	CS364	1800
1—	20	Gen. Elec.	KT312	1200
1—	20	Whse.	CS	1200
3—	20	G.E. NEW b.b.	K364	1200
1—	20	Whse. b.b.	CS334	3600

ARTHUR WAGNER COMPANY

1435 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 6-7409

NOW-

AGsco Shop Facilities as well as Reputation have reached from Coast to Coast

• • • •

NEW AGSCO plant just across the bay from San Francisco

DIESEL ELECTRIC POWER

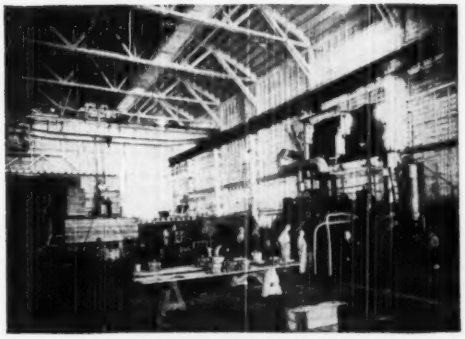
for Immediate Delivery

OTHER DIESELS AVAILABLE

UNIT CAPACITIES—10 TO 1420 KVA

A.C.—50 AND 60 CYCLES

VARIOUS VOLTAGES



Interior View of AGSCO Main Shop at Sausalito (S.F.), Calif. Showing 1000 KW GMC Diesel Unit During Test Run.

PARTIAL LIST OF OUR INVENTORY

KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33F16	2000	300
1420	Fairbanks Morse	38D	1600	720
1250	General Motors	16-278A	1600	720
1250	Nelseco	6M1-53	1500	300
1000	General Motors	12-278A	1200	720
937.5	General Motors	12-567	1080	720
625	Alco	6-12-½x13T	750	600
625	Superior	OS	750	327
425	Baldwin	VO	510	450
400	Buckeye	80	480	600
375	Enterprise	DSG-6	450	450
330	Superior	KNA	396	514
312.5	Cooper-Bessemer	FSN6	375	900
312.5	General Motors	8-268A	450	1200
312.5	Clark	MD-4	375	327
300	Fairbanks Morse	YVA	360	257
250	General Motors	8-268A	350	1200
200	Buckeye	80	240	600
187.5	Ingersoll Rand	S	225	514
156	Buckeye	E	190	400
125	General Motors	3-268A	150	1200
121	Fairbanks Morse	32E14	140	300
75	General Motors	6-71	90	1200
75	Fairbanks Morse	35E	90	450
62.5	Int'l Harvester	UD-18	76	1200
50	General Motors	4-71	60	1200
25	Hill	4R	31	1200

WRITE FOR ADDITIONAL INFORMATION

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER ESTABLISHED 1895

Diesel Engines • Power Machinery *Company, Inc.*

52 CHURCH STREET, NEW YORK 7, N. Y. PHONE Digby 9-4350

Reliably Rebuilt Electrical Equipment

40th YEAR

SPECIAL

3—300 H.P. Electric Machy. Synchronous Motors, .8 PF, 3 ph., 60 cy., 440 volts, 1200 RPM with Automatic Starter and Motor Generator Exciter.

Rebuilt — 1 YEAR GUARANTEE

PARTIAL LISTINGS ONLY

MOTORS
Squirrel Cage 3 Phase

H.P.	Make	Type	Speed
500	West. (2)	CS	1160
450	G.E.(vert.)	KF-6338	1180
300	G.E.	IK	900
250	G.E.	FT	3560
250	L.A.	OGS-1378	1150
200	Wagner	RP2	1750
200	G.E.	KF-6335	880
150	West. (2)	CS	1750
150	West.	CS	580
147	West.	CS (25 cy.)	715
125	Al.Ch. (2)	AR	435
100	Wagner New	XP	1150
100	G.E.	K-544	1175
100	West.	CS	870
100	G.E. (2)	IK	575
75	West.	CS	1750
75	G.E. (2)	K-505	1175
75	G.E.	IK	900
75	G.E. (3)	KT-352	865
75	West.	CS	720
75	G.E.	K-356 1	690
75	G.E.	KT-558	580
60	F-M	Tot. Enc.	1800
60	West. (2)	CS-607	880
60	Rel. (2)	AA	875
60	G.E.	KT-346	865
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	West.	CS	1740
50	L.A. (3)	XP	1150
50	West.	XP	1150
50	G.E.	KF-445	1170
50	West.	CS-642C	1160
50	West. (3)	CS	870
50	G.E. (2)	IK	870
50	G.E.	FTR-542	870
50	West.	CS	690

MOTORS
Slip Ring 3 Phase

H.P.	Make	Type	Speed
600	Cr.Wh.	131AQ	507
225	Wagner	25 cy.	710
200	G.E.	MTP-557	1800
200	G.E. (2)	IM	1170
150	Wagner	31VRN	900
150	G.E.	MT-564Y	580
100	G.E.	MT-553	1165
100	Al.Ch.		690
65	West.	CW	1150
65	G.E.		690
50	West.	HF	850
50	Al.Ch.		690
50	G.E.	MT-536	1150
50	West.	CW	1150
50	G.E.	MT-336	1150
50	L.A.	OGH	870
50	F-M	BV	600
50	Al.Ch.	ARY	575
50	G.E.	IM	490

MOTORS
Synchronous

H.P.	Make	Type	Speed
475	West.		720
400	G.E. (2)	TS-928S	600
300	El.Mchy.(3)		1200
300	G.E.	ATI	900
260	G.E.	TS	900
200	G.E.	TS	1200
200	G.E. (2	25 cy.	500
200	Ideal	SMW	257
180	G.E.	ATI	900
160	G.E.	TS	1200
145	G.E.	ATI	720
135	West.	G	1200
135	Ideal		1200
100	G.E.	TS	1200
55	El.Mchy.	BRKT	1200

MOTORS
550V. D.C.

H.P.	Make	Type	Speed
735	G.E. (6)	MFC	1045/1350

MOTORS
230V. D.C.

H.P.	Make	Type	Speed
125	G.E.	RC-15	1750
100	G.E.	RC-14	1750
100	Al.Ch.		1150
90/45	G.E.	RF-17	950/475
75	Sprague		1000/1500
75	West. (2)	SK-180	475
75	Cr.Wh.	LT	480/670
75	Cr.Wh.	CMC	375/950
60	West. (3)	SK-160	680
50	G.E.	RC-12	1750
50	Diehl		850/1050
45/90	G.E.	RF-17	475/1950
25/75	Cr.Wh.	CCM	475/1950
25/75	Cr.Wh.	CCM	165/800
50	West. (3)	SK-160	565
50	G.E.	RF-17	250/1000
50	West.	SK	250/1000
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC-31	1700
40	G.E.	RC-32	1100
40	G.E.	RC-34	750
40	G.E. (2)	CD-1441	400/1500
40	Cr.Wh.	CCM	700
40	Rel.	461T	400/1200
35	West.	SK-120	1150
35	G.E.	RLC	440/800
30	G.E. (3)	CDM-85	2200
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West. (2)	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	G.E.	*CDM-77	1750
25	E.D.	108	1500
25	Rel.	92T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	600
25	G.E.	RF-14	300/1200

MOTORS
115V. D.C.

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CMC	900
40	G.E.	CD-113	850
30	West.	S	600
25	G.E. (2)	CD	1800
25	West.	SK-103	1150
25	Cr.Wh.	CCM	750
25	West.	SA	600/1200
15	E.D.	71⁄2S	650/1230
15	Cr.Wh.	CM	650
12½	G.E. (3)	CDM-85	930/1160
12½	G.E.	*CDM-95	930/1160
10	Century	DN-334	1750
10	G.E. (2)	RC	1200
10	Al.Ch.		900
10	E.D.	71⁄2S	425/1700
10	Diehl		230

GENERATORS — A.C.
Driven by D.C. Motors

KVA	Make	D.C. Input	A.C. Output
288	West	115	450
75	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	El.Mchy.	230	440
18	G.E.	220	120/240
10	Burke	115	120
7½	Hertner	115	440
5	El.Spec.	115	110
1¼	Al.Ch.	230	110

GENERATORS — A.C.

KW	Make	Type	Speed
216	West.	G	900
180	G.E.	ATB	900
100	G.E.	ATB	360
75	G.E. (2)	ATB	1200
50	F-M	GG	1200
15	G.E.	ASI	1200

Frequency Changers and Generators

Size	Make	Output Frequency
150 KW	G.E.	150 cy.
154 KVA	G.E.	150 cy.
125 KVA	West. (2)	180 cy.
50 KW	G.E.	120 cy.
40 KW	G.E.	100 cy.
30 KW	G.E.	90 cy.
15 KW	G.E.	408 cy.
10 KW	G.E.	200/700 cy.
7½ KW	G.E.	408 cy.
3 KW	G.E.	408 cy.

GENERATORS
600V. M D.C.

KW	Make	Speed
400	G.E. (4)	1200
200	Cr. Wh.	900
200	West.	1150
150	West.	1150
60	G.E.	1200
30	Burke	1750

GENERATORS
250V. D.C. Motor Driven

KW	Make	Speed
1000	G.E.	900
500	West.	1100
300	Elliott	1200
300	G.E.	1200
300	Al. Ch.	1200
200	G.E.	1200
150	West.	900
100	Delco	1200
75	G.E.	1200
50	G.E.	1200
40	Rel. (4)	1750
42	ABC (2)	1200
30	G.E.	1200
25	G.E.	1200

GENERATORS
125V. D.C. Motor Driven

KW	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100	West. (2)	900
100	G.E.	1200
100	El. Mchy	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	West.	1150
50	Cr. Wh.	1150
50	Sturt.	2800
35	Ideal	1200
30	G.E.	1150
30	L.A.	1450
25	El. Mchy. (2)	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
8000	H-V-W	6/12
5000	Optimus	6/12
1500	H-V-W	6/12
125	Hobart (8)	7½
1000	G.E.	15
750	Master	20
1500	Century	24
3000	El. Prod.	24
550	Col.	27
100	G.E.	30
1000	G.E.	33
150	Watton	40
200	G.E.	42
1500	G.E.	50
1500	Century	60
1500	G.E.	60
1000	G.E.	75

TRANSFORMERS

4—333 KVA Moloney, 2300/4600V. Primary, 230/460V. secondary.
1—300 KVA, Al. Ch. 3 ph, 4160V. Primary, 230V. Secondary.
1—300 KVA, Pittsburgh, 3 ph, 1—300 KVA, Pittsburgh, 3 ph, 4160 V. Primary, 230V. Secondar
8—100 KVA West. 3 ph. 440-220 Dry.
2—50 KVA G.E.—H—KF, 2400/4160V—120/240V. Sec.
4—25 KVA West. 440V. Primary, 110/220V. Sec.
3—15 KVA West. 440V. Primary, 110/220V. Sec.
60—Additional Oil and Insulated Dry-type Transformers in stock, not listed, down to 1 KVA.

STARTERS — A.C.

1—450 H.P. West. magnetic reduced voltage (550V.) Synch.
2—400 H.P. C-H Bulletin No. 9976, 440V. magnetic reduced voltage Synch.
1—250 H.P. C-H Bulletin No. 9589, 4150V.
1—200 H.P. G.E. CR-7065, 440V. Synch.
3—150 H.P. G.E. CR-7061, 220V. Synch.
2—100 H.P. C-H full voltage Synch.
40—C-H and A-B, 2 and 4 speed magnetic starters.
635—7½ H.P. C-H 440V. magnetic starters.

STARTERS — D.C.

1—600 H.P. 230V. West. magnetic.
150—New 230V. D.C. magnetic starters, from 5 H.P. to 75 H.P., C-H, G.E., etc.
100—New 230V. D.C. manua starters from 1 H.P. to 5 H.P.—G.E. and C-H.
40—New 7½ H.P 230V. magnetic reversing.
1—300 H.P. West. 230V. magnetic.
Over 250 additional D.C. starters in stock, not listed, all sizes and voltages.

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10th and Exeter Sts., READING, PA.
Phone Reading 2-6866

GLOW

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	4600	Westgh.
350	3550	2200	Westgh.-CS
300	1800	440	Al.-Ch.
300	900	440	GE-I-17
250	1200	440	GE-KTR
250	600	2300	Triumph
225	514	440	GE-I-14
200	450	2300	GE
200	600	440	Westg'h-CS
150	600	2200	GE
125	3600	220/440	Al.-Ch. AN
125	1200	440	Century
125	340	220	A-C
100	1200	2200	Al.-Ch. AR
95	3600	2200	GE
75	1200	2200	GE-KT
75	1200	220/440	GE-K505Y
75	900	2300	GE
607	3600	2300	GE-KT
60	1800	440	Lincoln
60	1800	2300	GE-FTR
50	3600	440	B. & M.
50	1800	220	Triumph
50	1200	220/440	GE-Tri-Glad
50	900	220	GE
50	720	2300	Wtg.-CS
40	1800	220	GE-KT
40	1200	550	A-C AN
40	900	2300	Wtg.-CS
40	900	220	Lincoln
40	720	440	GE-KT
35	1800	220	GE type I
35	600	440	GE-Type I Form M
30	1200	dual	Master
30	900	220	Lincoln
30	900	220	Wagner (Hi-Torque)
30	720	220	GE-BJ
30	514	440	Stanley
25	3600	dual	L-A
25	1800	220	L-A, HD
25	1200	220	Weeche
25	1150	208/416	Wtg.-CS
25	900	440	GE
25	690	220	Westgh., type CS
25	575	220	GE-type M

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TE-FC-BB
75	1200	2200	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	900	440	Reliance, TE-FC-BB
20	3600	dual	Delco-TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1200	220/440	Delco-TEFC-BB
15	900	440	GE-TE-FC-BB
10	3600	220/440	F-M
10	1200	440	GE-TE-FC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-Hi Slip-TE-BB
7½	1200	dual	Delco
7½	1090	220/440	GE-Hi Slip
7½	900	dual	Delco-TEFC-BB
5	3600	dual	Delco-TE-FC-BB
5*	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-B BB
5*	1200	dual	GE-TEFC-BB
3	3600	dual	Delco, TE-FC-BB
3	1800	dual	Delco-TEFC-BB
3	1200	440	GE-TEFC-BB
3	900	dual	Delco
2	1800	dual	Delco-TEFC-BB

*New Motor

ENCLOSED SQUIRREL CAGE Cont'd.

HP	RPM	Volts	Make
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	1800	dual	L. Al-TE-BB
1½	1200	dual	Delco-TEFC-BB
1½	900	dual	Delco-TEFC-BB
1	3600	220	Hoskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1	1200	220	GE-KT
¾	3600	440	Delco-TE
¾	1800	dual	Weeche-TE-BB
¾	900	dual	Delco-TEFC-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brs.
400	1200	2300	Al. Ch.
375	1800	2300	Al. Ch.
350	900	2300	Westgh.
300	720	2300	Al. Ch.
250	300	2300	Al. Ch.
225	1800	220	GE-I
200	1800	440	Al.-Ch.
150	1750	440	GE-MT
150	900	2200	Al. Ch.
75	1800	220	GE
75	900	440	Al.-Ch., ANY
75	720	2200	Wagner Type BR
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Weeche
50	1800	220	GE-MT
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	GE-MT-338
40	900	220	A-C
40	720	2300	Wtg.-BF
40	720	220	Al. Ch.-ARY
40	600	2300	Al. Ch.-ARY
40	600	440	Al. Ch.-ARV
40	450	220	Triumph-C
35	900	2200	GE
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE
35	570	550	GE-I
30	1800	2300	Wtg.-CW
30	1800	2300	GE
30	1200	440	Wagner
30	900	440	GE-MT
30	600	220	F. Morse-BV

VERTICAL MOTORS

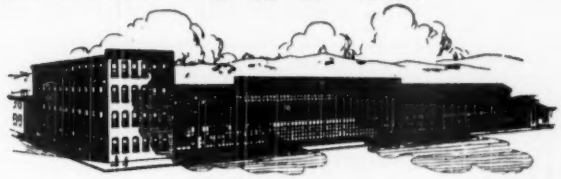
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
200	1200	2200	GE-I-SR
150	1200	440	GE-Cage
125	1200	2300	Al. Ch.-SR
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
75	360	220	Ideal-Cage
60	1800	220 D.C.	GE
60*	1200	440	Al. Ch.-C

VERTICAL MOTORS—Cont'd.

HP	RPM	Volts	Make
50	1800	2200	Wtg.-Cage
50	900	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C	GE
40	1200	440	GE-BR
40	1200	2200	Westgh.-BB-Cage
35	1200	2300	Al. Ch.-Cage
34	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20*	1200	440	Al. Ch.-Cage
20	800	230 D.C.	GE-RC
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al.-Ch.
13½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C	GE
6	850	110 D.C	Rel.
5	1400	115 D.C	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C	Watson
3	3600	dual	Delco
3	1700	230 D.C	Watson
3	1200	dual	Wtg.-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	500	2200	Wtg.-25 cycle
710	720	13200/6900	GE
500	514	440	GE
435	720	2300	GE TYPE ATI
320	900	2300	GE-ATI
250	1800	2300/4160	GE-ATI
250	225	2300	GE-TS
225	900	4160	GE-ATI
220	600	2300	GE-ATI
200	225	2300	Wtg., rotor & stator only
175	225	220	GE-TS (rotor & stator only)
160	600	440	GE-ATI
160	164	480	GE-TRF (rotor & stator only)
150	1800	2200	GE
150	1800	220	GE-ATI, Single Bearing
150	720	440	Westgh.
120	225	220	E-M, rotor & stator only
115	164	208	GE
100	1200	220	Wstg Single bearing
95	1200	220	Burke
75	1200	220	Westgh.
75	900	2300	GE-ATI-7552
60	360	2200	GE, rotor & stator
60	1200	440	Wagner
60	900	220/440	Westgh.
50	720	440	GE-TS
50	360	440	GE, rotor & stator
50	300	220/440	Wstg (rotor & stator only)
40	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg., rotor & stator
30	360	550	GE
30	327	220	E-M, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
20	1200	440	Wagner
20	900	220	Wtg.
20	600	220	E-M, rotor & stator



D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-MPC
50	120	Al.-Ch.
35	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	750	GE-A
20	700	Triumph
20	500/1800	GE-RF11
20	400/1200	GE-RLC fr. 203A
18	900	Sturtevant MPS
18	1200	J. & L.
15	1000	GE-CE
15	975	F-M
15	725	Westgh.-S fr 6
12	1075	J. & L.
12	830	Westgh.-SK-113
10	3450	Imperial
10	1700	Fairbanks-Morse
10	650	J. & L., type CI
10	400/1600	Watson-BW18B

GEAR HEAD MOTORS

60 Cycle, A.C.

HP	Output RPM	Volts	Phase	Description
20/10	375/185	440	3	Master-Two speed motor
10	450	220/440	3	Master-Vertical
5	6850	220/440	3	Master-Parallel
5	290/1800	220/440	3	Delco-Variable Speed Transmission
3	380	220	3	GE-Parallel
3	215/1500	3	3	Master-Vari-Drive
2	315	220/440	3	Master, Parallel
2	261	220/440	3	Master, Parallel
1½	5.4	220	3	Janette, Rt. Angle
1½	388	110/220	1	Master-Parallel
1	430	220/440	3	Master, Parallel
1	2.2 to 11	220/440	3	U.S. Varidrive
1	190	115/230	1	Master-Parallel shaft
¾	107.8	220/440	3	Janette, Rt. Angle
½	143	220	3	Master, Rt. Angle
½	190	220/440	3	Master-Parallel Shaft
½	99	220/440	3	GE-Rt. Angle
¼	269	440	3	Janette-Parallel Shaft
1/6	19	220/440	3	Master, PA-TERB
1/12	172.5	115	1	Wstgh. Rt. Angle

D. C. GENERATORS

125 Volts

KW	RPM	Description
540	1000/1800	Westgh., single bearing
500	750	GE-MC7
300	1500	GE-CC
300	900	GE-MPC
200	800	GE-DMC
100	1000	WE-DLC
100	900	Wstg.-SK single bearing
55	1000	GE-Type TD
40	800	J. & L.-F Ped. Type
38	1165	GE-DLC
31.25	1400	Westgh.-SK-single bearing

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Westgh., single bearing
200	1200	GE-MPC single bearing
175	450	Westgh.
80	1200	Al. Ch.-E-127
55	1800	GE-RC
30	300	Triumph
22½	765	Westgh.-SK
20	1750	Delco Ballbearing
18	900	Burke
18	350	Westgh.-SK

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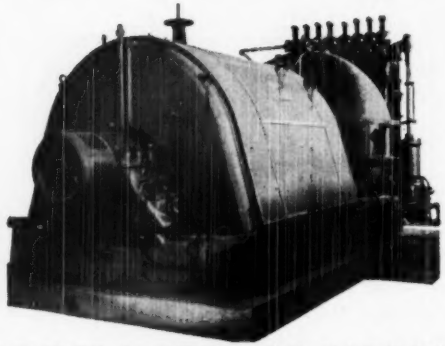
Any Capacity Desired from 25,000 KVA. to 625-KVA.

NEW (Never Erected) Units

2—5714-KVA. G.E. 600#, 750 FTT.: 12,500-KVA. G.E. 600#-750 FTT. 1000 - KVA., 440#, psi. 650 FTT.

Ask for our Prices



Above 6250-KVA., General Electric, Just Purchased, is in A1 Condition, Complete, 200#-psig, 2300/4160-v, 3600-RPM., with 7000 sq. ft. Condenser with Auxiliaries. Deliver Duty Free in Canada and the United States.
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2—New 4000 KW Cond. 2400 4160 V. 750° T.T.
1—3500 KW 2300 V Cond.
1—2500 KW 600 V Cond.
1—2500 KW 2300 V Cond.
1—2000 KW 600 V Cond.
1—1500 KW 2300 V Cond.
2—1250 KW 2300 V Cond.
1—1000 KW 2300 V non-C.
2—1000 KW 440 V Cond.
1—1000 KW 480 V Extract 300#
1— 750 KW 600 V Extr.
1— 750 KW 240 V Cond.
1— 600 KW 550 V NC— 70#
1— 600 KW 480 V Cond.
1— 600 KW 2300 V Cond.
1— 500 KW 2300 V Cond.
1— 250 KW 240 V Non-C.
1— 160 KW 220 V Non-C.
1— 150 KW 2300 V Non-C.

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(Continued)

1— 125 KW 600 V Extrac.
1— 100 KW 600 V Non-C.

TURBINE—Only

1—New 465 HP—3550 RPM 900 PSI.

WATER-WHEEL GENERATORS

2—250 KW Vert. 21' Hd. 3 ph. 60 cy—550 volts

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1—500 KW 2300 V Unit.
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1—375 KW 2300 V Unit.
1—168 KW 220 V Unit.
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1—6000 CFM 50# Motor
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1—6000 CFM 5.1# NEW
1—5000 CFM 10# Rotary Type Motor

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Save 40% to 60% One—Two—Four Stage

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29.5	250	Worth	BW580
40	500	IR	Type 20
61	1000	Worth	VS
105	350	CPT	T-CB
110	3000	IR	Type 40
140		Gardner Denver & Sullivan	WB and WL-60
170	125		
230			
285			
388	125	Worth	M-75
1055	110	IR	XRE
1290	125	Worth	VD
1452	70	Penn	DBI
2340	125	CPT	W-CE

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3—850 HP. 215#, 100° SH. B&W. four drum reconditioned by manufacturers in 1942. Stokers.
4—1530 HP. 320#, 650° F. Springfield, Cross Drum, in operation, inspection invited.

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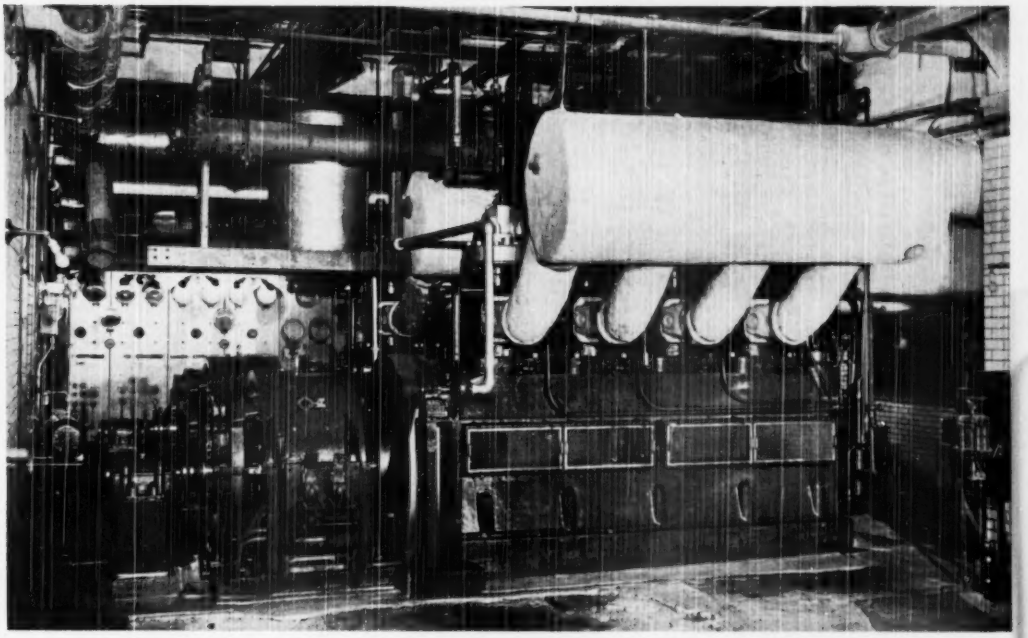

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40 HP Reliance Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 365T, 230 Volt, DC Motor.
With full magnetic control providing log forward, log reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	870	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
3	15	570	220	West.	CW-646
1	18	690	440	West.	MW-316
1	20	860	440	West.	CW-628
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	730	440	Wagner	22VBR
1	30	865	440	West.	CW-846
1	30	850	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	690	440	P-M	HV-H18A
2	40	865	2300	Al-Ch.	ARY-223C
1	40	568	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	860	440	West.	HP-12A
1	50	570	440	G.E.	MT-552
5	53‡	550	220	G.E.	IQC-5018***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5544
1	60	545	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5353
2	125	430	440	G.E.	IL-16
1	150	1750	440	G.E.	MTP-549
1	175	585	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	695	2200	G.E.	IM-17A
2	200	600	440	G.E.	IM-17
2	300	888	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
2	350	880	2200	G.E.	IM-17A
1	500	585	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	880	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

228 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. ‡‡ 25 Cycle.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding and Direct Connected Exciter

Quan.	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
5	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
10	3	850	Reliance	T-23T
25	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-65
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	850	Al.-Ch.	ARB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
1	15	825	West.	SK-95
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-20
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
6	5/7½	600/1855	G.E.	RA-50
1	10	400/1600	Reliance	T-92T
2	10/15	600/2400	Reliance	T-92T
1	12½	280/840	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RP-11
1	20/25	400/1600	Reliance	T-23-T
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RP-12
1	25/29	300/1500	G.E.	RP-12
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1600	Reliance	T-4611
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1500	Al.-Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	250/500	G.E.	MPC

**New

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy. Totally Enclosed Fan Cooled, Ball Bearing

Qn.	H.P.	R.P.M.	Volts	Make	Type
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	FX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-405B

Splashproof, Ball Bearing

Qn.	H.P.	R.P.M.	Volts	Make	Type
33	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-384
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-368
2	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078T
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qn.	H.P.	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC336
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
3	20**	1750	440	Wagner	RPI-364
2	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-512
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRH-354***
2	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-582C
2	40	900	2200	G.E.	FTR-536
4	50**	1750	440	Wagner	RPS-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-546
1	75	1160	440	West.	CS-682C
1	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-552
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-586B
2	300	587	2200	West.	CS-72A
1	400	1165	2200	G.E.	IK-E15B
1	500	1200	440	G.E.	KTP-587
1	700	1800	2300/4000	West.	CS-4-39D-13

220 volt motors can be reconnected for 440 volts.
** New. *** 2 Phase. ‡‡ Reconnectable for 440 volts.

G. E. DYNAMOMETERS

Cradle Type, with Control and Dial Scale
(Write for Complete Specifications)

Qn.	HP	D.C. Volts	RPM	Type
1	50/75	250	1680/4000	TLC-20
2	100	250	1050/3600	TLC-50
1	200	230	1200	C

MOTOR GENERATOR SETS
125 and 250 Volts D. C.
(Write for complete Specifications)

KW	Make	RPM	D.C. Volts	A.C. Volts
2	Cont.	1750	125	220/440
7.5**	West.	1435	125	550/2295‡
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440‡
16	West.	1750	125	2200/440
20	West.	1750	250	220/440
25	G.E.	1800	250	220/440
25	G.E.	1200	125	220/440
30	G.E.	1800	250	220/440
30	Al-Ch	1750	125	220/440
50	West.	1750	250	220/440
50	G.E.	720	125	220/440†
75	G.E.*	1200	125	220/440
75	G.E.	1200	250	2300/440
100	Columbia*	1200	250	2300/440
150	West.*	1200	250	2300/440

Note: 3KW, 5KW & 7.5 KW, 250 V. Sets Avail.
** New * Synch. Motor Driven. ‡ 50 Cy. † 25 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVE. CLEVELAND 14, OHIO

AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK

POWER PLANT EQUIPMENT

STEAM ENGINE GENERATOR SETS

2—575 KVA Skinner Unaflow—West. 240/480 V.
1—575 KVA Allis-Chalmers Corliss—220/440 V.
1—375 KVA Ames Vertical 220/440 V.
1—250 KVA Ridgeway four valve 2300 V.
1—187 KVA Ames Vertical 220/440 V.
1—156 KVA Ames Vertical 220/440 V.

STEAM TURBINE UNITS

Complete 2000 KW Turbo-Generator Plant:
1—1500 KW G.E. condensing—3600 RPM
1—500 KW G.E. condensing—3000 RPM
These units are of modern design, are 3 phase, 60 cycle, 2300 V.

DIESEL GENERATING UNITS

4 Diesel Generating Units, like new, comprising a complete diesel power plant, and consisting of two 450, one 300, and one 150 HP Fairbanks-Morse model 32-E engine-generator units. Engines are of all duplicate cylinder size, 2400/4160 V. 3 phase, 60 cycle. Late model Woodward governors, pumps, cooling tower, etc. Operated only a short time. Available for immediate delivery.

1—250 KVA—220/440 V. G.M. "twin"—NEW—not war surplus.

BEESON ENGINEERING CO.

1628 E. 7th St., Los Angeles 21, Cal.
MUtual 9151

ELECTRIC WHIRLEY CRANE AND STORAGE BINS

NEW 1941

Crane Boom 85'—4 Yard Bucket
5 Steel Bins Total Length 75'x18"
Distribution conveyors and elevators.

FURTHER INFORMATION ON REQUEST

BENKART STEEL & SUPPLY CO.
2017 Preble Ave., Pittsburgh 12, Pa.

FOR SALE

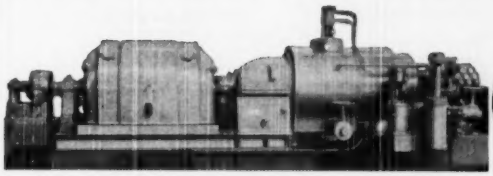
7 Panels—Modern G.E. Metal-clad 15 KV switch gear at approximately half price
1000 KW G.E. Turbo unit and condenser
Two 2000 Gal. pumps and motors. 10,000 lbs./Hrs. deaerating water heater
I-R Compressor 20,000 cfm at 100# pressure
Motor-driven Blower—40,000 cfm at 4 lbs.
2 motor generator sets 30 KW 125V output
600 HP 12-cylinder Hall Scott gas motor

ROOM 4200
316 SOUTH LA SALLE ST.
CHICAGO 4, ILL.

SPECIALS

3—752 HP B&W Stirling WT Boilers
2—84x18-72x18-66x18 HRT Boilers
2—15 KW, 125 V. Turbo Gen. Sets
4—125-110-75 HP Loco. Type Boilers
2—2000 CFM Air Compressors-Motors
1—650 & 450 HP Straight Tube Boilers
H. & P., 4719 Etzel, St. Louis 14, Mo.

POWER PLANT MACHINERY



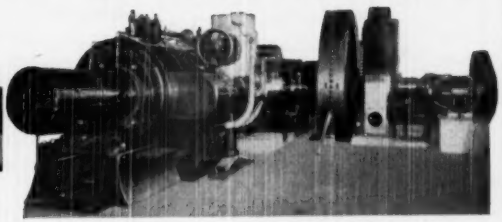
2500 KVA ALLIS CHALMERS CONDENSING TURBO UNIT

2000 KW 80% P.F. 2500 KVA Allis Chalmers Generator, 3 phase 60 cycle 4160/2300/600/480 volts, direct connected to 2000 KW Allis Chalmers condensing turbine, 400# steam pressure, 650° TT, 3600 RPM.

Equipped with direct connected exciter, surface condenser and auxiliaries.

This unit is designed for high efficiency. The full load steam consumption is approximately 11# steam per KW hour.

New 1933—Excellent Condition—Can be shown in operation



750 KVA SKINNER NON-CONDENSING UNIFLOW UNIT

750 KVA Westinghouse generator, 3 phase 60 cycle 2300/-600/480/240 volts, direct connected to Skinner Universal Uniflow non-condensing engine, 150# steam pressure, 5# back pressure, 150 RPM.

Equipped with belt driven exciter, and rheostats.

New 1931—Excellent Condition

Wire or phone for further details and prices.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. **Telephone: MAin 9514** **CLEVELAND 14, OHIO**

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—
220/440 VOLTS

H.P.	Make	Type	Frame	RPM
150	Gen. Elect.	IK-17		385
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1455
200	Westinghouse	CS	2200 volt	1500
350	Westinghouse	CW	Slip Ring	500
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

INDUCTION HEATING SET

GENERATOR—175 KVA General Electric A.C. Generator, type A.R.C. form AL, single phase, 800 volts, 3000 cycle, 1800 RPM, serial #5513639.

GENERATOR EXCITER—1 KW, General Electric Generator, type EE, form EB, 125 volts, D.C., 1800 RPM, 8 amps., serial #1758700.

MOTOR—300 HP General Electric synchronous motor, type TS, form EL, 3 P.F. 3 phase, 60 cycle, 440 volts, 1800 RPM, serial #5513638.

MOTOR EXCITER—3 KW, General Electric Generator, type EF, form EB, 125 volts, DC, 1800 RPM, 24 amps. serial #1758736.

Motor and Generator are direct connected, 4 bearing. Mounted on factory fabricated base, with direct connected exciters.

3000 Cycle Control is mounted in cubicle also containing 300 HP Gen. Elec. synchronous motor stairing control.

6250 KVA TURBO-GENERATOR

1—6250 KVA Gen. Elect. Unit—Generator 3 Phase, 60 cycle 2300/4160 Volts 3600 RPM. Complete Installation For Immediate Delivery.

200 HP SYNCHRONOUS MOTOR

200 HP Gen. Elect. Synch. Motor—New 3/60/2300/225 RPM—1.0 PF Engine type with M-G set for excitation and 200 HP Gen. Elec. New Full Voltage Syn. Dead Front Control Panel.

700 KW M.G. SET

2—350 KW Gen. Elect. Type MPC 250 volt. 720 RPM Generators will direct connect to 1000 HP Synchronous Motor or will sell Generators separately.

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 Volt DC, 1200 RPM, direct connected to

300 HP Westinghouse Synchronous motor 3/60/208/1200 RPM. A.C.—D.C. Panels—Like New

Immediate Shipment.

SLIP RING MOTORS
3 Phase—60 Cycle—220/440 Volts

H.P.	Make	Type-Frame	Speed	Remarks
2— 20	LaL	KH	900	
30	G.E.	MT-305	1800	
30	Cr. Wh.		1800	
3— 35	West.	CW	585	
35	G.E.	MT-342	690	
35	West.	MW	690	
40	West.	CW-748A	690	
6— 40	G.E.	MT-326	1200	
40	G.E.	MT-523	1800	
50	G.E.	MT-526	1200	
50	G.E.	MT-527	1800	
2— 50	West.	CW	1800	
60	G.E.	MT-533	1800	
60	West.	CW-453C	1800	
100	West.	CW	435	3 bearing
5—100	G.E.	I form M	900	
3—100	G.E.	MT-347	1800	
125	G.E.	I form M	1200	
3—250	G.E.	I form M-16	900	
350	West.	CW	435	2200 volts
500	Al. Ch.	ANY-WR	514	2200 volts
600	G.E.	MT	490	25 cycle

This motor will rewind satisfactorily to

700 G.E. MT 720

HORIZONTAL & DUPLEX
Compressor & Vacuum
Pumps after Coolers, Filters

NEW TRANSFORMERS
Stock Shipment

3—25 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—25 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—37½ KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—37½ KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—50 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—50 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
6—75 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
9—100 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
5—100 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
6—150 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—167 KVA Niagara O.I.S.C. 2400/100/240, 1 Phase, 60 cycle, with taps.
3—250 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase 60 cycle, with taps.
3—333 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.

TRANSFORMERS

3—100 KVA Gen. Elect. Transformers. Type H Form KF—2400/4160 volts primary 120/240 volts secondary. Price $450.00 each. Electrically O.K. F.O.B. truck, Minnesota.
3—50 KVA Gen. Elec. Transformers. Type H Form K—1 Phase 60 Cycle 2300 Volts Primary 115/230 Serial No. 3154858.
3—200 KVA Westinghouse Transformers. Type SK—1 Phase 25 Cycle 2300 Volts Primary 115/230 Volt. Secondary. Serial No. 1214690-90-91.

PLATING GENERATOR

3000 Amp. Hansen Van Winkle 6—12 volt. 400 RPM

FREQUENCY CHANGERS

All Sizes in Stock. 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 cycle and any other high cycle.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. **BUFFALO, N. Y.**
CL. 4758

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—12500 KVA Al. Ch. Cond. 60 cy. 6900 V. 250-lb. 600 deg. Surface Condenser.
1—12500 KVA Al. Ch. Cond. 60 cy. 13800 V. 240-lb.
1— 9375 KVA Cond. 50 cy. 13800 V. 600-lb. 825 deg. Surface condenser & Boiler. NEW.
1— 5000 KVA G. E. Non-C. 60 cy. 13200 V. 600-lb.
1— 3125 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lbs., 40 lbs. BP.
1— 2500 KVA G. E. Extraction Cond. 60 cy. 480 V. 185-200 lbs. steel valve chest.
1— 1563 KVA G. E. Extraction Cond. 60 cy. 480 V. 200-lbs.
1— 1250 KVA DeLaval Non-C. 60 cy. 2300 V. 250-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
1— 940 KVA Elliott Cond. 60 cy. 480 V. 400-lbs.
1— 937 KVA Al. Ch. Extraction Cond. 60 cy. 480 V., 150-200 lbs.
1— 125 KVA West. Non-C. 60 cy. 240/480 V. 150-lb., 3 lb. BP.
1— 25 KW Allis Non-C. DC 125 V. Exciter Dual drive turbine & motor.

BOILERS

2—1400 HP B. & W., 650 lb., 700 deg.
1—1000 HP Comb. Engr. 250-lb., 490 deg.
2— 509 HP B. & W., 200-lb., 486 deg.
2— 500 HP Sterling 180-lb. Coal & Oil.
3— 253 HP B. & W. 225-lb. Bent tube.
3— 250 HP Titusville 125-lb. Fire box.
2— 200 HP Erie Economic 125-lb. Stokers.
1— 180 HP Frost 200-lb. Return tubular.

DIESEL ENGINE UNITS

2—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
2— 900 HP M.A.N. 2300 V. 60 cy. NEW.
1— 720 HP Amer. Loco. 240 V. DC.
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 400 HP Fair. De La Vergne 2400 V. 60 cy.
2— 240 HP Fair. Morse 2400 V. 60 cy.

STEAM ENGINE UNITS

1—1125 KVA Nordberg Uniflow, 480 V.
1— 312 KVA Skinner Uniflow, 480 V.
1— 250 KVA Ames Vertical Uniflow, 480 V.
2— 187 KVA Ames Vertical Uniflow, 240/480 V.

NEW MOTORS STOCK 20-200 HP

SYNCHRONOUS MOTORS—60 cy.

2—3000 HP G. E. 2300 V. 257 RPM
1— 880 HP G. E. 6600 V. 514 RPM
1— 600 HP G. E. 440 V. 360 RPM
2— 500 HP E. M. 2200 V. 514 RPM
1— 350 HP G. E. 440 V. 900 RPM
2— 350 HP G. E. 2300 V. 257 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM
1— 200 HP G. E. 220 V. 600 RPM

INDUCTION MOTORS—60 Cy.

1—8000 HP Cr. Wh. S/R 2200 V. 885 RPM
2— 450 HP West. S/C 4150 V. 360 RPM
1— 300 HP West. S/R 2200 V. 1770 RPM
1— 250 HP G. E. S/R 2200 V. 1800 RPM
3— 200 HP E. M. S/C 480 V. 1800 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 720 RPM. NEW.
1— 200 HP G. E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM. NEW.
1— 150 HP Cr. Wh. S/C 440 V. 1200 RPM. NEW.
1— 150 HP Cr. Wh. S/C 440 V. 900 RPM. NEW.
1— 75 HP Al. Ch. S/C 440 V. 900 RPM.
3— 75 HP Cr. Wh. S/C 220/440 V. 1200 RPM

MOTOR GENERATOR SETS

2—1500 KW West. 250 V. DC 60 cy.
2—1000 KW G. E. 600 V. DC 60 cy.
1— 750 KW G. E. 275 V. DC 60 cy.
2— 300 KW G. E. 250 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.

ROTARIES—60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2160/2700 KW Gen. Elec. 240/300 V.
2—2000 KW Gen. Elec. 600 V.
1—1000 KW Westinghouse 600 V.

MERCURY ARC RECTIFIERS

2—4500 KW Multi Anode 600 V. DC
2—3250 KW Ignitron 650 V. DC
1—1650 KW Ignitron 275 V. DC

FREQUENCY CHANGERS

1—12500 KVA G. E. 25/60 cy. 300 RPM
1— 2500 KVA G. E. 25/60 cy. 300 RPM
1— 1250 KVA West. 25/60 cy. 300 RPM
2— 1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS—60 Cy.

4— 333 KVA West. 132000—7620/13200
1— 2000 KVA G. E. 69000—13800/23900, 3 ph.
3—1000 KVA West. 66000—11000
3—1000 KVA West. 66000—7200
1— 5000 KVA West. 34500—13750, 3 ph.
1— 5000 KVA G. E. 33000—2300/4000, 3 ph.
1— 3000 KVA West. 33000—2300/3990, 3 ph.
6— 50 KVA G. E. 33000—2300
6— 75 KVA Meloney 33000—2300/6900
3—3750 KVA West. 26400/13200—2400
4— 450 KVA Al. Ch. 25410/44000—13280/23000
3—1000 KVA Pittsburgh 22000/11000—2200
1— 750 KVA G. E. 13200—480, 3 ph. Unit. Sub.
2— 200 KVA G. E. 11500—230/110
3— 200 KVA Meloney 11000—2300
1— 167 KVA G. E. 7200/12400—240/480
1—1500 KVA West. 4000—2300, 3 ph. Auto
3— 750 KVA Al. Ch. 2300—480
3— 500 KVA Pittsburgh 2300—230/460
3— 20 KVA West. 2200—575/287½
12— 15 KVA Standard 450/225—117/234
2—27½ KVA G. E. 440—220/110

OIL CIRCUIT BREAKERS

1— 600 A. 73 KV G. E. FHKO-138 Outdoor
1— 600 A. 37 KV G. E. FHKO-136-CS Outdoor
1— 400 A. 37 KV Condit FO-40-B Outdoor
2— 400 A. 37 KV West. G-11 Outdoor
1—1200 A. 34.5 KV G. E. FKO-339-1000 Outdoor
1—1200 A. 25 KV G. E. FHKO-258 Outdoor
4—2000 A. 23 KV G. E. FKO-339-1000 Outdoor
4— 600 A. 15 KV G. E. FHKO-138BS Outdoor

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BREW, WOLTMAN & CO., INC.

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POWER PLANT EQUIPMENT

3—40,000 lbs. per hour B. & W. Type "E"

Boilers, 450 psi; complete plant.

QUICK DELIVERY

For complete description and quotation

WIRE——WRITE——PHONE

FLETCHER SALES COMPANY

629 FINCASTLE BLDG. LOUISVILLE, KENTUCKY

WABASH 6026

DIESEL GENERATOR SET!

225 HP Busch Sulzer Model DF, 3 cyl., 4 cycle, solid injection, 360 RPM. Direct connected 150 KW 3/60/2300 volt generator with direct connected exciter, air filter, muffler, etc. A modern unit in perfect condition only $4000 f.o.b. St. Louis.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St. St. Louis 1, Mo.

STEEL STORAGE TANKS

2—1000 & 2—10,000 Bbl. New Vertical
6—74,000, 55,000 & 37,500 Bbl. Vert.
9—25,000 Gal. Cap. Horizontal
50—10,000 & 9—20,000 Gal. Horizontal
6—10,000 & 12,000 & 10,000 Gal. ¼" Shell
20—10,000 Gal. Cap. 60 lbs. Press. Test

L. M. STANHOPE, Rosemont, Penna.

FOR SALE

Dean Hill 20" cast iron bronze fitted centrifugal pump direct connected to 200 H.P. Westinghouse 600 r.p.m. explosion proof motor, 60 cycle, 2200 V. 3 phase. 12,000 G.P.M. @ 54' head. Sell together $3,000 or pump @ $1,400, motor at $1,800. Dealer inquiries invited.

A. C. GUSTAFSON

2105 McKINNEY, HOUSTON 3, TEXAS

Vertical Hydro-electric Units

2—800 KVA 3 ph. 60 cy. 2300 v. 225 RPM for 28-34' head
2—370 KVA 3 ph. 60 cy. 2300 v. 225 RPM for 9-13½' head
1—225 KW 3 ph. 60 cy. 2300 v. 180 RPM for 18-22' head
1—185 KW 3 ph. 60 cy. 2300 v. 150 RPM for 10-15' head
1—144 KW 3 ph. 60 cy. 550 v. 120 RPM for 9-13' head
1— 80 KW 3 ph. 60 cy. 2300 v. 300 RPM for 12-22' head.
1—1300 KW Vert. unit complete for 50' hd.
2—800 KW units horiz. for 50' hd.

Several horizontal units in good condition priced to sell. All subject to prior sale. We are headquarters for good hydroelectric units. For full particulars write

WM. C. MOULTON ASSOCIATES
MONSON, MASS.

250 KVA and 750 KVA DIESEL ENGINE A.C. GENERATOR SETS

Several Now in Our Stock

Send for Illustrated Free Bulletins 320,525 — today

A FEW OTHER DIESEL POWER UNITS IN OUR STOCK:
—Hamiltons, 1600-HP., 720-RPM., with West. Reversing Reduction Gears: SAME AS NEW: 15—Baldwin-Westinghouse 300-KW. DC., 240-v., 400 RPM.: 4—GM. Model 3-268-A. 100-KW. 4—FM. O.P. 1200-HP., 720-RPM., Engines. 8-cyl. Nearly New. AND MANY OTHERS. Write Us, Stating Your Requirements.

Our stock is large and includes almost anything wanted in Diesel Power

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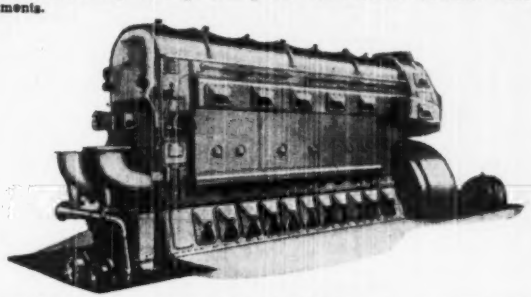

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Same on Turbine-Generators and Boilers

Cut shows Fairbanks-Morse 1600-HP., Opposed Piston Engine, direct connected to a NEW 1250-KVA., 3/60/2300/4160-v. AC. Generator.
These machines are specially adapted for ALL Stationary and Marine Installations. Many Municipals are now operating them.

TURBO-GENERATORS: We Carry one of the largest stocks in the USA. New and Used.

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Immediate Deliveries
Right Prices

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NEW AND REBUILT ELECTRIC POWER EQUIPMENT

Squirrel Cage Motors—3 Phase

H.P.	Make	Type	Speed
250(2)	G.E.	KF550	1800
200(3)	G.E.	IK	450
150(3)	G.E.	IK	600
150	West.	CS-856C	900
150(3)	Century	SCN585W	1200
150	West.	CS	1800
150	G.E.	KT547B	1800
125	G.E.	K542E	1200
125	Century	SCN584W	1200
125(2)	G.E.	K546	1200
125	G.E.	IK	600
100	Al. Ch.		720
100	West.	CS762C	900
100	G.E.	KTF542	1800
100	Cr. Wh.	CW335B	1800
100(2)	West.	CS445	3600
75	G.E.	IK	450
75	G.E.	IK	514
75(3)	G.E.	IK	600
75	Fair. M.	BH24A	600
75(2)	G.E.	KT556	720
75(3)	G.E.	IK	720
75	West.	CS	720
75(6)	G.E.	IK	900
75	G.E.	KT352	900
75	G.E.	KT552	900
75(2)	G.E.	KT547	1200
75	Louis Allis	FAN505	1200
75	Diehl	18178	1200
75(2)	Al. Ch.	AE	1800

Synchronous Motors—3 Phase

350	G.E.	ATI	600
300	G.E.	TS-974T	720
220	G.E.	ATI-PM	600
200	G.E.	ATI-6304D	257
150	G.E.	TS-7641	720
145(3)	West.	SC1238	1200
108(3)	G.E.	TS954Y	1200
75	G.E.	ATI-PC	900

Squirrel Cage Motors—2 Phase

50(4)	West.	CS	1200
40	West.	CS	1200
30	West.	CS	720
25	Fair. M.	H12B	900
25	West.	CS	1750

3 Phase—25 Cycle—Motors

200	G.E.	IM	720
150	West.	HP	360
150	G.E.	IK	720
100	G.E.	IM	485
100	G.E.	MTC5353	750
100	Lincoln	IQ	720
100	West.	CS (Gear Hd.)	900
75	G.E.	IK	500
75	G.E.	IK	750
75	West.	CW-773C	750
50	Century	SC50	750
50	Burke	N-5058	1500
40(2)	G.E.	MTC-5333	750

Slip Ring Motors—3 Phase

450	West.	CW	500
300	G.E.	MTC5566Z	600
275	G.E.	I	360
150	Al. Ch.	ANY	600
150	Fair M.	HV-Z20C	1800
100	G.E.	IM	1800
75	Al. Ch.	ANY	600
60	G.E.	MTC-5546	600
60	G.E.	MT-546	900
52	Otis	35A	720/240
50	G.E.	IM	450
50	G.E.	IM	720
50	G.E.	MT-552	720
50	G.E.	MT-542	900

Slip Ring Motors—2 Phase

150	G.E.	MQP549	1800
52	G.E.	IQC5012	900
50(6)	Al. Ch.	ANY 26C	900
50	G.E. (Vertical)	MQ536	1200
40	Al. Ch.	ART	720
30	Al. Ch.	ART-220C	900
25	Al. Ch.	ART	600
25	Al. Ch.	ART220C	900
25	G.E.	MQ326	1200

PARTIAL LIST ONLY

230 Volt—DC—Motors

150(2)	Cr. Wh.	83H (TEFC)	900
150	G.E.	CDP125	1800
135	Burke	WAM-15	1200
113(4)	Cr. Wh.	HHL	1750
100	G.E.	CDM1239Y	1200
100	Elec. Dynamic	100M	1800
90	West.	SK-1-83-H	575
62½(3)	West.	SK125L	1750
60(2)	G.E.	CDM-95	1800
59(3)	G.E.	CO-2007	470
50	West.	CK9	600
50	West.	SK220	94/170
50	G.E.	RLC204	500/1500
50(12)	Burke	WA6S	1450
40	Cr. Wh.	50H	750/1000
40(4)	Cr. Wh.	EH-M	1800
40	Century	DN454	1800
35	G.E.	RLC	450/1300
30	Reliance	319T	400/1400
30	Al. Ch.	EH-127S	600/1400

PARTIAL LIST ONLY

115 Volt—DC—Motors

100	G.E.	CDM1242Y	1200
80	Cr. Wh.	CMC-50H	1200
65	G.E.	CDM-1135Z	1200
60	Cr. Wh.	CMC125H	240/1200
25	G.E.	RC21B	1200
15	West.	CK7	850
15	West.	SK83	1300
15	G.E.	RC19A	1750
15	Elec. Specialty	US3	1750
15(2)	West.	SK	1750
14/17	G.E.	RA20	1650/2100
10	G.E.	RC2B	850
10	G.E.	RC28A	1150
10	West.	SK70L	1750

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SPECIAL

A.C. and D.C. NEW MOTORS available at tremendous savings. Large inventory. Immediate Delivery. Ask for our list.

EMPIRE ELECTRIC COMPANY, INC.

87-93 JAY STREET — PHONE MAIN 4-5900 — BROOKLYN 1, NEW YORK

POWER EQUIPMENT—READY TO SHIP

A.C. MOTORS—3 PH. 60 CY.

No.	HP.	Make	Type	Speed	Volts
1 NEW	200	West.	SYN	1200	220/440
1	250	Burke	SYN	720	2200
1 vert	250	G.E.		1175	2200
1	200	G.E.	I	860	2200
1	300	G.E.	SYN	1800	2200/550
1	175	West.	MS	1200	220/440
1	150	West.	SYN	257	220/440
1	150	West.	SYN	900	220/440
1 NEW	150	El. Machy.		720	4160/2300
1	150	West.	SYN	900	2300
1	150	G.E.	I-K	1200	2200/220/440
1	150	West.	MS	1200	220/440
3	150	Louis Allis	FX	1750	220/440
1	125	West.	hi-torq	1115	220/440
1 NEW	125	West.	SYN	1200	220/440
1	125	G.E.	I-K	900	220/440
1 NEW	125	G.E.	TEFC	880	2200/440/220
1 NEW	125	Elec. Mach.		580	2300/440
1	125	Elec. Mach.	SYN	164	220/440
1	125	West.	TEFC	3600	220/440
1	112	West.	SYN	1200	220/440
1	100	Reliance	IT	495	220/440
1	100	G.E.	I	720	220/440
1	100	Al. Chal.		720	220/440
1	100	G.E.	I-K	900	220/440
1	100	G.E.	I-K	900	2200
1	100	West.	hi-torq	830	220/440
1	100	West.	SYN	900	220/440
1	100	Cr. Wh.	SC	1100	2200/220/440
1	100	Louis Allis	OGS	1750	220/440
1 NEW	75	Al. Chal.	AR	865	220/440
1	75	Stanley		600	220/440
1	75	Al. Chal.		580	220/440
1	75	West.	CS-877C	860	220/440
1	75	G.E.	I-K	900	220/440
1	75	G.E.	I-K	720	2200
1	75	G.E.	I	720	220/440
1	75	Louis Allis	OGS	1200	220/440
1	75	Burke		1200	220/440
1	75	Louis Allis	FAA-505Y	1150	220/440
2	75	West.	CS (TEFC)	1750	220/440
1	60	Al. Chal.		515	220/440
1	60	G.E.	I-K	600	220/440
1	60	Cr. Wh.	SC	720	220/440
5 NEW	60	West.	CS-607 (EXPLOSION PROOF — TEFC)	900	220/440
1	60	Burke	B	900	220/440
1	60	Triumph		1200	220/440
1	60	G.E.		1800	550
1	60	Elec. Dyn.	drip pr.	3600	4000/2300
1	50	G.E.	KT-546	720	220/440
1	50	Cr. Wh.		900	220/440
1	50	Wagner	Fynn Weichel	900	220/440
1	50	Triumph	B	850	220/440
2	50	West.	CS	860	220/440
2	50	G.E.	KT	1200	220/440
2 NEW	50	Reliance (TEFC)	B-504-S	1750	2200
3 NEW	50	G.E. (TEFC)	K-504	1750	2200
1 NEW	30	West.	CS-445 hi-torq	900	220/440

SPECIAL BARGAINS
Diesel Engine Generator Sets

1—100 KW., 120/240 V.D.C. Delco Generators dir. con. to 150 HP., Model GBD-8, 5½x7, 8 cyl, Superior Diesel Engines, elec. start, power panel, accessories. Practically new—only used for spares

4—100 KW., 220/440 V. A.C. 3 ph. 60 cy. West. Gen. dir. con. to 150 HP. Superior Diesels same as above

2—100 KW., 220/440 V. A.C. 3 ph. 60 cy. West. dir. con. 150 HP. General Motors DIESEL Model 3-268A, 3 cyl.

2—75 kva. 220/440 V. A.C. 3 ph. 60 cy. Delco dir. con. Cummins Diesel engines

2—37½ kva. 220/440 V. A.C. 3 ph. 60 cy. dir. con. Buda Diesel Engines

1—NEW 7½ kva. 120/V. 3 ph. 60 cy. Wisconsin GASOLINE

10—3 kva. 120 V. single or 3 phase, 60 cy. Hobart A.C. Generators dir. con. to Hercules GASOLINE ENGINES with panels

SLIP RING MOTORS—3 ph. 60 cy.

No.	HP.	Make	RPM	Volts
1	800	Westg.	595	6600
1	400	G.E.	450	2200
1	250	Cr. Wh.	600	440/220
1	100	Triumph	580	550/440/220
1	75	G.E.	1200	220/440
1	60	G.E.	870	220/440
1	60	Westg.	900	220/440
1	60	Burke	1200	220/440
1	50	G.E.	570	220/440
1	50	Allis Chal.	690	220/440
3	50	Westg.	870	2200
1	50	G.E.	900	220/440
1	50/32	G.E.	800/610	220/440
1	30	Elec. Dy	1165	220/440

VARIABLE SPEED MOTORS—230 V. D.C.

No.	HP.	Make	Type	RPM
1	200	Westg.	SK-210	500/750
1	125	G.E.	CD	400/1200
1	100	Westg.	SK-190	500/1000
1	100	G.E.	CD-165	400/1200
1 NEW	60	Westg.	CD	850/1700
1	50	Westg.	SK-170	350/1050

DIESEL & GASOLINE COMPRESSORS

1—315 cfm Ing. Rand portable 100# pres. driven by 105 hp. Waukesha Oil Engine.

1—315 cfm Schramm 100# pres. dir con. Buda Gasoline Engine rubber pneumatic tires

2—105 cfm Penna. 100# pres. driven by Buda Gas Engines

1—195 cfm Ing. Rand portable with Waukesha Engine

AXIAL FLOW VENTILATING FANS

25—6000 cfm Sturtevant Bulletin 512389, 3" stat. pres. 7 blade, dir. con. 5/1.5 HP., 1765/1175 rpm., 220/440 v. 3 ph. 60 cy. West. TEFC Motors.

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA.	Make	RPM	Volts
1 new	250	Westg.	1200	220/440
4 New	100	West.	1200	220/440
1	100	Elec. Mach.	164	220/440
1	100	Westg.	600	220/440
1	75	Elec. Mach.	900	220/440
10 New	37½	West.	900	220/440
11 New	25	West. (single Phase)	900	120

MOTOR GENERATOR SETS—250 V.D.C.

Motors 220/440 volt or 2200 volt 3 phase, 60 cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	150	Westinghouse	720
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200
3	90	Westinghouse	600
4	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
1 NEW	50	General Electric	1800
3	48	Westinghouse	900
3	30	Westinghouse	720

125 V. DC M.G. Sets

1—100 kw. G.E. 125 v. 900 rpm. 220/440 v. 3 ph. 60 cy. AC Syn.

1—75 kw. West. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. Syn.

ENGINE GENERATOR SETS

1—125 kva. 220/440 v. 3 ph. 60 cy. 257 rpm. Erie Ball STEAM.

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 220/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v 1200 rpm., D.C. Exciter and Westg. Reduction Gear.—Non-cond.

SPECIAL BARGAIN AIR COMPRESSOR

6—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con., to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

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Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

NORTHERN METAL CO.

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REDUCED PRICES

IMMEDIATE DELIVERY

Yarrow 3 Drum Bent Tube
Max. Steam per hr. 65,000 lb.
Normal 55,000 lb.
Working Pressure 225 P.S.I.
Test Pressure 387 P.S.I.
Heating Surface 6256 Sq. Ft.

Cleaver Brooks
Fire Tube Marine Package Type 60 H.P.
100 lb. Max. Working Pressure
2,000 lb. Steam per hr. at 35 lb. pressure

Wickes Water Tube, 3 Drum
55,000 lb. Steam per hr. normal
65,000 lb. Steam per hr. max.
628 H.P.
Working Pressure, 250 lb.

Babcock & Wilcox Water Tube Boilers
22,500 lb. Steam per hr.
Working Pressure 250 P.S.I.
Heating Surface 4874 Sq. Ft.

NUMEROUS OTHER ITEMS ARE AVAILABLE FOR INDUSTRIAL USE

MILNOR & BLEIGH STS. • PHILA. 35, PA.

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10 to 1000 H. P.

NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
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MURRAY HILL 7-6547-8-9

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asme — BOILERS — nat'l. b'd.

3—404 H.P. Springfield sectional, oil
1—250 H.P. Stirling, Coxe stoker
2—500 H.P. Erie City, oil
2—400 H.P. Stirling type, Spreader stoker
3—84" } Suspended HRT, hand fired
3—72" }

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Used Overhead Cranes
Structural Steel Buildings
Inquiries Invited

BENKART STEEL & SUPPLY COMPANY
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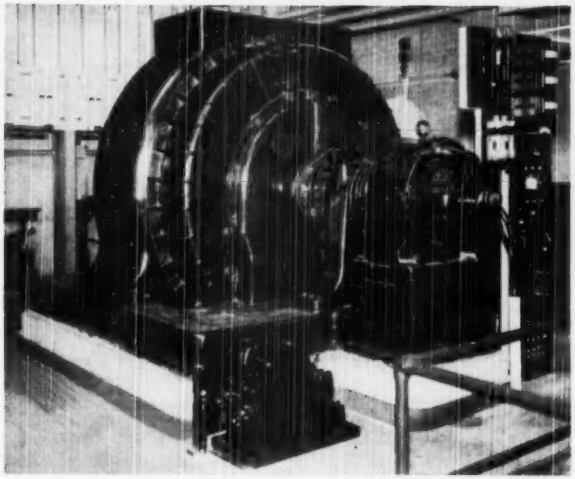

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5000 KVA Westinghouse Electric Corporation 3 phase 60 cycle 4000 volt, 725 amperes, 720 RPM synchronous condenser Serial #4240814 equipped with a 125 volt, 280 amperes, Type SK, 720 RPM direct connected exciter, switchboard and instruments. Can be converted as a *synchronous motor* developing 4000 HP, at either 80 or 100% P.F.

In addition to this offering we have available a large number of steam turbine generator units, motor generator sets, rotary converters, large alternating and direct current motors.

UMC UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

VACUUM PUMP

For Sale—Kinney High Vacuum Pump, Model DVD 18-1420. Capacity 702 cubic feet per minute. Also motor controls and 40 HP, 2 phase—60 cycle, 220-440 volt motor.

PRICED RIGHT

In use only 18 months—priced to sell fast.

Inquiries Invited

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Telephone LOcust 7-6104

600 KW DIRECT CURRENT GENERAL MOTORS DIESEL SET, Westinghouse Generator 500 Volt, 720 RPM. Electric Start. Unused.

450 HP ENTERPRISE DIESEL ENGINE, Model DSG-6, 6 cyl., 4 cycle, 450 RPM, air start, solid injection. Unused.

Other sizes in stock from 10 to 1000 KW.

ALJOHN DIESEL CO., INC.
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STerling 3-6515

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Diesel Gasoline and Steam Generators, Electrical and Industrial Equipment

POWERITE CORPORATION
140 Cedar St. New York 6, N. Y.
Dept. 105 BA 7-8199

Quality SINCE 1906 — Wente Motors — WIDE SELECTION UNUSUAL VALUES

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT . . . BY EXPERTS

SQUIRREL CAGE
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	G.E.	I (2200 V.)	900
2	50	Al. Ch.		900
1	60	G.E.	KT	1800
4	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	75	G.E.	KT	1250
1	100	G.E.	KT (2200 V.)	900
4	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1800
1	120	G.E.	FT	3600
2	125	Cr. Wh.	126Q	450
8	125	Al. Ch.	AB	450
3	150	Al. Ch.		1750
1	250	G.E.	I-17	900
1	250	G.E.	KF (Vert.)	3600

SLIP RING—SYNCHRONOUS
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

1	50	Al. Ch.		720
1	50	Ideal	AV	600
1	50	G.E.	I	700
1	60	Ideal	AVX	1200
1	75	West.	CW	400
1	75	G.E.	I	520
1	75	Fair. Morse	RV (2200 V.)	1800
1	100	G.E.	TRB (1.0 PF)	600
1	100	G.E.	I-16 (2200 V.)	450
1	100	West.	CW (8.P.)	1800
1	100	KW G.E.	ATB (.8 PF)	900
1	125	Fair. Morse	T (2400V)(PF1.0)	900
1	150	G.E.	TH (.8 PF)	1800
1	150	West.	CW	450
1	200	G.E.	THC (.8 PF)	400

D.C.—230 Volt
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	West.	SK	850
1	50	G.E.	CD 1341	500/3000
3	50	Reliance	T	1700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1800
1	75	Diehl	K11	700
1	100	West.	SK	850
1	100	Cr. Wh.	CM	600
1	130	Cr. Wh.	CMC (550 V.)	1200
1	150	West.	SK	850
1	180	Cr. Wh.	CMC	450
2	200	G.E.	TLC-74	1350/4000

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
4— 50 KW G.E. 60 V DC—440 V AC 1200 RPM
2— 75 KW El. Prod. 220 V DC—440 V AC 1200 RPM
1—100 KW Reliance 230 V DC—220 V AC 1200 RPM
1—100 KW Hilde 250/275 V DC—440 V AC 1200 RPM
1—105 KW Century 70 V DC—440 V AC 1500 RPM
1—150 KW G.E. 250/275 V DC—440 V AC 900 RPM

ALSO—4000 motors other than listed from 1 HP to 200 HP

The Wente Electric Co., Hamilton 203 NO. FOURTH ST. Phone 4-8128 Ohio

MOTORS - M.G. SETS - CONTROLS

AT REDUCED PRICES!

M-G SETS

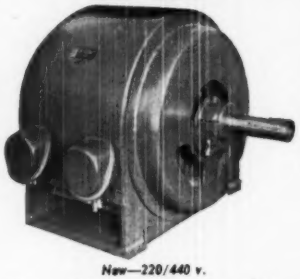
G.E. 600 KW M-G SET
250 volts D.C., 900 RPM, 875 HP, TS, 80% P.F. Syn. Motor. Complete with control. Can furnish for any A.C. voltage.

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2200	C-W
400	125/250	2300	Ideal
300	250	2200	G.E.
300	125/250	2300	Allis
200	250	2200	Whse.
200	125/250	2200	G.E.
150	250	440	G.E.
125	250	440	Whse.
100	250	440	G.E.
75	250	440	C-W
60	250	220	G.E.
50	230	440	Whse.

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
800	150	440	G.E.	80%
650	138	2200	Whse.	Engine
600	450	2200	G.E.	80%
500	514	440	E-M	100%
500	600	2200	E-M	100%
400	900	2300	Whse.	80%
400	720	440	G.E.	80%
400	600	440	G.E.	100%

SLIP RING



New—220/440 v.

HP	RPM	Mfg.	Shaft
500	1200	Elliott	4½ x 8"
125	720	Elliott	4 x 12"
100	720	Elliott	4 x 12"

Reconditioned and guaranteed

HP	RPM	Volts	Mfg.
700	720	2300	Allis
500	450	2300	G.E.
450	514	440	Whse.
350	900	2300	Whse.
350	450	2300	Whse.
250	900	440	Whse.
200	1200	440	G.E.
150	900	2300	C-W
125	900	440	Whse.
125	720	440	E-M
100	600	2200	A-C

NEW DIRECT CURRENT

230 VOLTS
Drip proof — ball bearing

Qu.	HP	RPM	Mfg.	Frame
5	250	1750	A-C	149
2	75	1750	F-M	1589
1	75	400/1200	Rel.	651-T
5	30	850/1700	Rel.	230-T
1	10	575/2300	L-A	4051
3	10	1750	Rel.	34-T
5	7½	575/2300	G.E.	77-CD
15	5	850/1700	G.E.	66-CD
3	3	690/2660	G.E.	284

Reconditioned and guaranteed

230 VOLTS D.C.

HP	RPM	Mfg.	Brg.
250	400/1200	E-D	Ball
200	300/900	Whse.	Ped.
200	400/1200	Rel.	Ball
150	350/1200	Whse.	Ped.
150	300/1050	C-W	Ball
125	400/1200	G.E.	Slv.
125	300/900	Rel.	Slv.
100	600/1500	Rel.	Ball
100	500/1500	C-W	Ball
100	475/1350	E-D	Slv.
75	500/1500	C-W	Ball
60	400/1200	Whse.	Slv.
50	350/1050	Whse.	Ball

NEW SLIP RING CONTROLS
15—250 HP 440/3/60 Fully Magnetic, Reversing, 7 steps acceleration, Allis-Chalmers, with air ckt. brkr. Open or enclosed.

Buy from BOSWICK with confidence

BOSWICK ELECTRIC CO.

WAlbridge 1195

P.O. BOX 55 AKRON 9, OHIO

DIESEL GENERATOR PLANTS

COMPLETE WITH SWITCHBOARDS

1000 KW to 100 KW
STATIONARY and PORTABLE
AT GREATLY REDUCED PRICES
NEW UNIT GUARANTEE

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

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Cable Address HEMCOY

1412 So. Alameda Street
Compton, Calif.

Used MACHINERY FOR SALE

2 Hagen automatic draft controls, control board and indicators.

1 Republic flow CO_2 recorder, never used. In original crate.

2 Combustion Engineering Type E stokers rated for better than 375 H.P. each.

1 150 KVA., 120 K.W., 80° power factor, 50°, 300 RPM., 240 Volts, 3 Phase 60 cycle, ac., flywheel type. Ideal Electric Generator.

1 125 Volt, 40°, 2-bearing, 1750 R.P.M. exciter for above generator including "V" belt drive.

1 Generator control panel for above. May be purchased separately or in lot.

PH. DIETZ COAL CO., Inc.
61-20 71st Ave., Ridgewood (27), N. Y.
Tel. HEgeman 3-3400

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NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGERS

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0488

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

WATER SOFTENER

Cochrane Hot Lime-soda process unit complete. Design IJS. Capacity, 6000 G.P.H. Used only one year. *Priced for quick sale.*

The STANDARD LIME and STONE CO.
Baltimore 3, Maryland

IMMEDIATE SHIPMENT

BLOWERS
10000 CFM 1.9" SP, Everdur Blades, Type R, Buffalo.
18000 CFM 7¾" SP, Type SE, #12, American.
15000 CFM 1½" SP, N. Y. Blower, Type ME, Size 27. UNUSED.
5300 CFM 1¼" SP, N. Y. Blower, Type M, Size 49. UNUSED.
70000 CFM 10" SP, Sturtevant Turbo #2. (Other Blowers from 1000-50000 CFM)

BOILERS
Dowtherm, 500,000 BTU, 125# pressure, Natl. Board, gas fired.

COAL PULVERIZERS
UNUSED Babcock & Wilcox Model E35, 9000#/hr., 57 grindability. NEW 1947.

COMPRESSORS
I.R. Centrifugal, 4 stage, single flow, 6500 CFM, 10#, M.D. UNUSED
Frick, Ammonia, 4x4 Type G.

DIESEL GENERATORS
60 KW G.M. 6-71RC 3/60/127-220, complete. Used only 100 hrs.
100 KW Hercules DNX-8, 3/60/127-220. Unit completely enclosed.
100 KW Superior GDB-8 120/240 DC, comp.

GAS PURIFICATION SYSTEM
Complete with tanks, valves, piping. Cap. 2000 to 16000 cu. ft. per hr.

MOTORS
Large quantity NEW T.E. and X.P. from ½ to 150 HP.

STACKS
5'3"x110', welded, ⅛" & ⅜".
42"x37' high, ⅛" & ⅜".

TRANSFORMERS
1 to 1500 KVA, All Voltages.

WELDERS
300 & 400 amps. G. E. & Hobart.

HEAT & POWER CO., INC.
70 Pine St. New York 5, N. Y.
Digby 8-0373

AXIAL FLOW FANS
Buffalo NEW Sturtevant
for Ventilating, Cooling, Heating, Drying, Blowing, Exhausting etc. Ideal for static resistance applications to 4" W.G. 9 sizes in stock 15"-36"; capacity 2000-30,000 cfm.
VERY ATTRACTIVE PRICES
direct connected waterproof motors, 3 phase 50/60 cycle 220, 380, 440, 500, 550 volt some DC also available in 115 and 230 volt.
COMPACT, QUIET, ECONOMICAL, VERY EFFICIENT
PRICES, CURVES, DIMENSIONS ETC. ON REQUEST
KODY ENGINEERING CO.
Box 765 Trenton 5, N. J.

50,000 lb. Integral Furnace 400 lb. B & W boiler complete with pulverized coal burners.
1500 KW 2400 volt GE Cond. turbine nozzled 150 lbs. capable changing pressure up to 400 lbs.
285 KVA 240 volt Chute Uniflow engine set.
100 KW 250 volt GE Rotary Converter with 2300 volt transformers.
200-150-100 & 50 KW Sys. M. G. Sets 2200 AC 250 DC
H. BLANE JOHNSON & ASSOCIATES
55 W. JACKSON BLVD., CHICAGO 4, ILL.

FOR SALE — BRAND NEW GE & WEST. CAPACITORS

No.	Name	Style	Volt	KVA	Cy	PH
19	GE	18F117	425	15	60	1
18	GE	18F130	515	15	60	1
47	GE	18F126	484	15	60	1
2	GE	18F258	460	15	60	1
18	GE	18F127	400	15	60	1
2	GE	18F120	3000V	Max. DC		
2	GE	9CH5877	575	15	60	1
48	West.	1178505	480	15	60	1
9	West.	ZZY22	4000V	DC		

Also Square D, GE, CN Solenoids, Hydraulic Solenoids. Allen Bradley Drum & Push Button Switches, Misarta Sheets.

CIMCO
2432 WEST THIRD STREET
CLEVELAND 13, OHIO

FROM AVAILABLE STOCK
Rebuilt to N.I.S.A. Standards

MOTOR GENERATOR SETS
3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2300/4400
1	1250	G.E.	600	575	2300
1	1000	G.E.	720	250	2300/13200
1	1000	Whse.	900	600	2300/4150
1	1000	West.	514	250	4150
1	800	G.E.(3U)	1200	120/240	2300
1	750	Whse	900	250	2300
1	500	G.E.	720	600	2300/4150
1	500	G.E.	720	125	2300/4000
2	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	2300/4150
1	300	G.E.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	140(3U)	Cr. Wh.	690	125/250	2300
1	100	G.E.	1170	125	220
1	75	Cr. Wh.	1170	250	220/440
1	75	Cr. Wh.	1200	250	550

ROTARY CONVERTERS
60 Cycle

	Make	Speed	D.C. Volts	A.C. Volts
1—2000	G.E.	514	600	13800
1—2000	G.E.	450	600	2300
1—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
3— 500	Whse.	1200	250	11000

RECTIFIERS

1— 750	G.E.	BBW	575	2300
1—1000	A.C.	B-612	625	13500
1—1000*	A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Auto Extraction 250# 18P 15# Ext. 2400V. 3 ph. 60 cy.
1	2000	G.E.	Condensing, 175# 18P—6600V, 3 ph. 60 cy
1	1000	G.E.	Condensing 135/150# 18P 2300/4150 V 3 ph. 60 cy.
2	750	G.E.	Condensing 250/275# 18P 440V, 3 ph. 60 cy. (New 1944)
2	400	G.E.	Condensing 275# 18P Geared to 1200 RPM. 120/240V. D.C. Generator.
1	300	G.E.	Non-condensing 150/175# 18P 5/15# B.P. 480V 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# 18P Geared to 1200 RPM 120/240V D. C.
	200	Cr. Wh.	Condensing 250# 18P Geared to 1200 RPM—125V. D.C. Gen.
1	200	Whse.	Non-condensing 150# 18P 7# B.P. 240V. 3 ph. 60 cy.

TRANSFORMERS
60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
1	2500	Packard	AT	3	13800 x 2300
1	2500	Al. Ch.	OISC	3	13200 x 2300
3	1000	Pitts	OISC	1	13200 x 2300
3	1250	G.E.	H	1	6600 x 550
1	1050	G.E.	WCTH	3	11000 x 445
1	1000	Maloney	OISC	3	13200 x 480
1	600	Al. Ch.	OISC	3	4900/2300 x 216
3	333	Pitts	OISC	1	26100 x 2600
3	250	Al. Ch.	OISC	1	2300 x 130
3	200	Whse.	OISC	1	7200 x 240/480
6	167	G.E.	OISC	1	3400 x 240/480

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse.		600	525/720
1—1500	Whse.		525	600
1—1200	Whse.		600	625
1—600/1000	Whse.		450	600/720
1—650	G.E.	MPC	250	115/145
1—600	Al. Ch.	MILL	250	400/500
1—300/400	G.E.	DYNA	250	1325/2500
1—325	Whse.	MG	250	300/900
1—200/260	G.E.	MPC	230	360/920
1—275	Whse.	QM 600-8	230	425/850
1—250	G.E.	MPC	230	480/500
1—250	Al. Ch.		230	760
1—150	G.E.	MPC	230	250/450
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	880

FREQUENCY CHANGERS

1—2000	G.E.	25/60 Cycle	2300/2300V
1—500	A.C.	25/60 cycle	11000/2300V

A. C. MOTORS
3 ph. 60 cycle
SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—2500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4600	514
2—2000	Whse.		2300	120
1—1000	Whse.		2300	128½
2— 900	Al. Ch.	(New)	2200	150
1— 650	Whse.	NG	2200	138
1— 600	Whse.	Syn.	440	360
1— 500	G.E.	ATI	480	900
1— 500	G.E.	TS	4150	600
1— 450	Whse.	Eng.	2200	128.5
2— 350	G.E.	TS	2300	154
1— 320	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 300	Al. Ch.		440	600

SLIP RING

1—1000	Whse.	CW	2300	700
2— 700	Whse.	CW	2300	900
1— 500	G.E.	IP	550	562
1— 500	G.E.	IM-Mill	2300	450
3— 450	G.E.	IM	440	566
1— 600	G.E.	MT 412	440/2300	705
2— 350	Whse.	CW	2300	900
1— 350	G.E.	MT-442Y	2300/4000	253
1— 300	Al. Ch.	S. Brg.	2300	505
1— 300	G.E.	IM	440	720
9— 300	Al. Ch.	ANY	2300	709
1— 250	G.E.	MT-434Y	4000	257
1— 250	G.E.	MT-555S	2300	1750
4— 100	G.E.	MT-566Y	440/2300	425
2— 100	G.E.	IM-16	2200	435
2— 100	G.E.	IM	440	600
3— 100	Al. Ch.	AK	2200	1200

SQUIRREL CAGE

1— 250	G.E.	KT-558	440	800
1— 200	G.E.	JK	550	865
1— 200	G.E.	KT-557	440	1800
1— 200/112	G.E.	KF-559BB	440	1170/885
1— 125	Whse.	M9	440	435
1— 125	(New) G.E.	KF-TEFC	440	1190
1— 125	G.E.	KF-TEFC	440	3585
2— 100	Al. Ch.	AK	2200	1170
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-543	220/440	1750

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720

RE NU BILT BELYEA MOTORS

BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.
Phone: Journal Square 2-3334
N.Y. Line: REctor 2-7150

COMPLETE POWER PLANTS
STEAM — ELECTRIC — HYDRO — DIESEL
"Export Orders Carefully Executed"

BOILER UNITS
1—140,000# New Steam Generator 600#, also Super
2—60,000# Boilers, 625#, 825° F.tt., Economizer and Air-heater
2—60,000# MODERN Boilers 400#
2—30,000 MODERN Steam Generators 450#
3—1000 HP Vogt 380# with Superheater
2—1040 HP Heine Boilers—Super 200#
3—750 HP Stirling Type Boilers 200#
1— 400 HP B&W Co. Sectional—Super 200 to 350#
4— 500 HP B&W Sectional Header 200# Boilers.
2— 350 HP Straight Tube 200# Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS
1—20,000 KW Turbo-Generator—Cond.
1—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond.
1— 5,000 KW Turbo-Generator—Cond.
3— 2,500 KW same as above
3— 2,000 KW same as above
2— 1,500 KW same as above
3— 1,250 KW same as above
2— 1,000 KW same as above
} Also 400 & 600# Turbos
1—500 KW same—Also 750 KW & 300 KW Units
Non-Cond.:—300 - 500 - 750 - 1000 - 1500 - 2000

COMPLETE STEAM PLANTS: One with 2-1500 KVA's, One of 2500 KVA & One of 7500 KVA.
Frequency Changers—Transformers! Send us your requirements—We may have it.
Send us your INQUIRIES *for* ALL POWER MACHINERY
CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

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ELECTRICAL POWER EQUIPMENT

SAVE 40 TO 60% IN PRICE
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NEW EQUIPMENT PERFORMANCE
WITH

CHICAGO *Electric* GUARANTEED "REBUILTS"

HERE'S A PARTIAL LISTING OF OUR TREMENDOUS STOCK

SQUIRREL CAGE MOTORS
3 Phase, 60 Cycle—220 or 440 Volt
(*2200 Volt or Higher)

HP	Make	Type	Speed
750	*G.E.	KT	720
700	*G.E.	KF-58947	1800
600	*Westg.	CS-6-34-15	1200
600	*G.E.	K-559DZ	3600
500	*G.E.	IK	1800
500	G.E.	KTP-567	1200
500	G.E.	IK	900
400	*G.E.	IK	1800
400	*Westg.	CS-936	1800
400	Al. Ch.	ANW	900
400	*Westg. Vert.	CS	720
400	G.E.	IK	600
350	*Westg.	CS	900
350	G.E.	IK	600
350	G.E.	IK-14	514
300	G.E.	FT-559A	1800
300	G.E.	K-559BZ	1200
300	G.E.	IK	900
250	G.E.	KT-559	1800
250	*Westg.	CS-875S	1800
250	*G.E.	IK	900
250	G.E.	KT-564	900
250	Westg.	CS	900
250	*G.E.	IK	600
200	*Al. Ch. BB	AB	1800
200	Wagner	24V	1800
200	Westg. BB	CS	1800
200	Reliance	AA-C69855	1200
200	*Westg.	CS	1200
200	*Westg.	CS-950A	900
200	*G.E.	K	720
200	Westg.	CS-32B	720
200	Westg.	CS-950A	600
200	G.E.	IK-15A	450
150	Westg.	CS-771-1C	1750
150	*Westg.	CS	1200
150	Cont. TEFC	NP-745K	900
150	Westg.	CS-950A	600
150	*G.E.	KT-564	600
125	Westg. BB	CS	2600
125	G.E. TEFC	K-6326S	1200
125	*G.E.	K	1200
125	Al. Ch. BB	AR-828D8	1200
125	Al.Ch.NEW	AR-626F	900
100	*G.E.	KT	1800
100	Al. Ch. NEW	ARWW-823E	1200
100	Burk	EM-12.5	1200
100	U.S. Vert.	CFU-994A	1200
100	Al. Ch. BB	ARZ-828	900
100	G.E.	K-6331	720
75	*Al. Ch.	AR-223-B8	1800
75	Al. Ch. BB	AR-505	1200
75	Al. Ch.	AR	1200
75	G.E. TEFC	K-505	1200
75	G.E. NEW	K-505	1200
75	*Westg. Vert.	CS	900
75	G.E.	FT-558	720
75	*G.E.	IK	720

SYN. A.C. MOTORS
3 phase, 60 cycle
240 or 480 volts

H.P.	Make	Type	P.F.	Speed
2100	G.E.	ATI	.8	514
1750	G.E.	ATI		3600
1000	Westg.		.8	900
700	G.E.	ATI	.8	720
600	Westg.		1.0	138
400	G.E.	T8-9828	1.0	600
375	Westg.		.8	1200
350	G.E.	T8-765S	.8	900
320	Al. Ch.	Dr. Prf.	1.0	720
300	G.E.	T8-965S		1800
300	G.E.	ATI	1.0	600
250	Al. Ch.		1.0	720
200	Al. Ch.		1.0	360
145	G.E.	ATI	.8	600
125	G.E.	T8-954B	1.0	1200
125	Cr. Wh.	103-S	1.0	900
100	G.E.	T8-954B	.8	1200
100	G.E.	ATI	.8	900

A.C. GENERATORS
3 Phase, 60 Cycle
240 or 480 Volts

KVA	Make	Type	P.F.	Speed
5000	Al.Ch.			450
300	Westg.			200
1500	Westg.			900
1000	Westg.		1.0	900
1000	Westg.		.8	150
875	El.Mach.		.8	212
700	G.E.		1.0	720
500	Al. Ch.		1.0	900
375	Westg.		.8	1200
312	Westg.	3 brg.		600
300	Westg.		.8	300
250	Al.Ch.		1.0	720
156	G.E.	ATI	1.0	600
110	Cr. Wh.	103-S	.8	900
112.5	G.E.	T8-954S	.8	1200
100	G.E.	ATB	.8	900
60	Fr.Morse	D-D400	.8	360
60	Fr.Morse	B	.8	900
50	G.E.	ATB	.8	1200
50	Westg.		.8	1200

COMPENSATORS
3 phase, 60 cycle

HP.	Make	Type	Volt
300	G.E.	CR-1034	440
200	G.E.	CR-1034	440
150	G.E.	CR-1034	220
150	G.E.	CR-1034	440
125	A.B.	55-3	440
125	G.E.	CR-1034	440
100	A.B.	55-3	220
100	Westg.	A-5	440
100	Al. Ch.	RD-31	2300
100	G.E.	CR-1034	220

CHICAGO ELECTRIC

Has a modern up - to - date plant that houses a tremendous stock of:

- AC Motors
- DC Motors
- Generators
- M.G. Sets
- Transformers
- Compressors
- Switchboards
- Controls
- Hoists
- Pumps

PHONE CANAL 6-2900 TODAY

1st Source for 40 Years for Quality Electrical Equipment

CHICAGO *Electric* Co.

1320 W. CERMAK ROAD **CHICAGO 8, ILL.**
PHONE: CAnal 6-2900

1—Fairbanks-Morse and Co., 6 cylinder, Model 32-E-14, 45 HP, 300 RPM, Diesel engine, S/N 876106. Equipment direct connected to 300 KW, Type TGZP, Frame VI, 375 KVA, 80% P.F., 240 volt, 3 phase, 60 cycle, 300 RPM, 903 Amps, Fairbanks-Morse alternator. Fairbanks-Morse V belt driven exciter, Type DG, Frame LA-326, S/N X70134, 10 KW, 125 volts. With panel board on which are mounted:

1 G.E. air circuit breaker. Type AL2-50, 600 volt, 60 cycle, 1000 Amp, 3 poles, 1 Burlington regulator, size GB4B, G.E. 0-300 scale volt meter, G.E. 0-1500 scale ammeter.

PORTER
ELECTRIC COMPANY, Inc.
116 THIRD AVENUE, NORTH
MINNEAPOLIS 1, MINNESOTA
LINCOLN 7531
Electrical Equipment Coast to Coast

MODERN DIESEL GENERATING PLANT

300 HP used Fairbanks-Morse Diesel engine, model 32-E-14, serial #795310, direct connected to 200 KW Fairbanks-Morse generator, .8 PF, 3 phase, 60 cycle, 240 volt (can be reconnected to 440 volt). Complete with switch gear, starting equipment, pumps, enclosed cooling system, circuit breaker, silencer and stack.

30 KW new Consolidated portable generator set.

PRICED TO SELL

DENNY & CLARK
1923 W. North Ave., Chicago 22, Ill.

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

FOR SALE

150 HP FYNN WEICHSEL SYNCHRONOUS MOTOR

900 RPM, 3 phase, 440 Volts 60 cycles. Complete with control equipment.

ELECTRIC APPARATUS REPAIR COMPANY
1400 No. 6th Street, Phila. 22, Pa.

TRANSFORMERS
FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. **Philadelphia 20, Pa.**

ELECTRICAL CABLE

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2500 KVA Al. Chal. 2300/4160 v., 400#
1625 KVA Wghse. 2300 v., 150# (bleeder)
1250 KVA GE 480 v., 180# (bleeder)
1250 KVA Elliott 2300 v., 200# (bleeder)
1250 KVA (2) Elliott 480 v., 150/200#
1250 KVA Wghse. 2300 v., 450#
1250 KVA GE 4150 v., 200#
937 KVA Elliott 2300 v., 175# (bleeder)
750 KVA GE 2300 v., 200#
625 KVA GE-Murray 2300/4160 v., 240#
375 KVA Wghse. 220/110 v., 100/125#
375 KVA Al. Chal. 480/240 v., 190#

TURBO UNITS (Non-Cond.)

937 KVA Al. Chal. 480 v., 150#
625 KVA GE 2300 v., 150/200#
250 KVA GE 600 v., 150/200#
62½ KVA; 112 KVA; 125 KVA; 200 KVA and 250 KVA GE 480/220 v. units

DIESEL UNITS

250 KVA (2) Buckeye 2300/480 v.
250 KVA FM 2400/480/240 v.
200 KVA FM-FM: 2400/480/240 v.
156 KVA Ideal-Buckeye 240/480 v.
109 KVA GE-Superior 240/480 v.
93 KVA GE-Superior 480/240 v.
75 KVA (2) GM 2400 480/240 v.
75 KVA (2) GM 480/240 v.
37½ KVA GM 240 v.

BOILERS

625 HP Vogt bent tube 450#
540 HP Keeler 250#
490 HP (2) Erie City 3 drum, 160#
480 HP Springfield straight tube, 250#
420 HP Erie City 3 drum, 160#
400 HP Erie City, Heine type, 200#
350 HP Keeler 2 drum, 160#
250 HP (2) Kewanee fire box 125#
250 HP (3) Titusville fire box 125#
214 HP Kewanee fire box 125#

STEAM ENGINE SETS, A.C.

900 KVA GE-Skinner Unif. ver. (new)
500 KVA GE-Skinner Unif.
450 KVA GE-Ames Unif. Cond.
312 KVA GE-Chuse 4 v.
312 KVA GE-Ames Unif.
312 KVA (2) CW-Skinner Unif.
187 KVA GE-Chuse 4 v.
187 KVA Wghse.-Ames Unif. Ver.
62½ KVA GE-Ames Unif.

PUMPS — MOTOR DRIVEN

COMPRESSORS — MOTOR DRIVEN

TRANSFORMERS

MOTOR GENERATOR SETS

POWER PLANT EQUIPMENT CO., INC.

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New York, N. Y.

FOR SALE
M.G. SETS

2 CROCKER WHEELER
250 KW 1200 RPM MOTOR 208V
3 PHASE 60 CTCL GEN. 250V
3 WIRE NEUTRAL 125V 250 AMPS
125% LOAD 2 HRS COMPL. WITH SWITCHING GEAR.

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one 20 ton York Vertical Ammonia Compressor. Steam driven by Corliss Engine—140# pressure.

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Also specialize in
Diesel Generators—Turbo—Generators
Write—Wire—Phone

DEAN G. STRICKLER & ASSOCIATES
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BOILERS FOR SALE

Two new 178 hp locomotive type boilers 15 lbs. pressure. Cost new each $6000. Any reasonable offer will be considered. Details furnished.

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Bargain, complete Diesel Power Plant for cheap and emergency power, consisting of 300, 150 and 75 KW; 3 ph.; 60 cy.; 2400 v. units, Fairbanks Morse Modern Unit; Engineering service available.

Diesel, 521 K of P Bld., Indianapolis Ind.
Tel. Lincoln 4007

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One 6 cylinder Macintosh-Seymour (now American Locomotive Co.) Diesel Engine, Serial #2035, Model 6-C-46, 4-cycle, 1250 H.P. at 164 R.P.M., direct connected to G.E. 2300 Volt, A.C., 2-phase, 60-cycle 1060 K.V.A. generator and G.E. direct connected exciter complete with generator field rheostat, exciter field rheostat, lube oil pump and motor, and complete with necessary watthour, ampere, voltage, power factor meters and necessary current and potential transformers.

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Offers will be received to 2:00 P.M. February 10, 1950, by the *COMMISSIONER OF PUBLIC UTILITIES, Rockville Centre, N. Y.*

Write for further information.

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MODERN 1000 KW Turbo-Generator

In Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

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1—125 KW BUCKEYE 400 RPM
1—100 KW BUCKEYE 400 RPM
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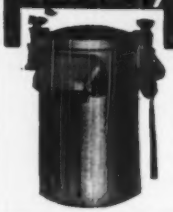

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SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
450	440/220	Whse.	514
250	2200/440	Whse.	600
300	440/220	Whse.	514
300	440/220	Whse.	900
200	2300/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse.	600
150	440/220	Whse. (2)	1800
150	2200/440	G.E.	1200
150	440/220	G.E.	720
100	440/220	G.E.	600
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2300/550	G.E.	1800
75	440/220	Whse. 25 cy.	750

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
600	2300/440	G.E.	T.S.	1200
400	440/230	G.E.	ATI	600
300	2200/440	G.E.	TS	720
300	440/230	G.E.	ATI	600
250	440/230	Whse.	HR	277
250	440/230	G.E.	ATI	600
240	440/230	Whse.	G	1800
200	440/230	G.E.	TS	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/230	Whse.	G	1800
75	2200/440	Whse.	GE	600

GENERATOR SETS

1—62½ kva. 1200 rpm. 220 volt, Whse., geared to 7200 rpm. Whse., non-cond. steam turbine, 150 lbs. pr.
2—unused 25 kva. 120/208 v., 3 ph., 1200 rpm. generator dir. conn. to Waukesha 6 cyl. gas engine

AIR COMPRESSOR UNIT

1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm, 110 lbs. gs. motor-driven.

CIRCUIT BREAKERS

3—2000 amp., GG K, 3 pole, 600 v., air
3—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
350	2300	G.E.	KT	1200
300	2200/550	Whse.	CS	1800
250	440	G.E.	KT	900
250	2300/440	L. Allis	OGS	1200
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	G.E.	IK	450
100	2300/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	D. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G.E.	IK	514
125	440/220 (2)	G.E.	IK	514
125 vert.	440/220	G.E.	KTP	1200
100	550	Cr. Wh.	Q	900
100	2200/440	G.E.	K	1200

A. C. GENERATORS

1—800 kva. 1200 rpm. 2300/440 v., G.E.
1—320 kva. 600 rpm. 440/220 v., G.E.
1—250 kva. 720 rpm. 2300/440 v., G.E.
1—250 kva. 600 rpm. 2200/440 v., G.E.
1—225 kva. 600 rpm. 220/440 v., G.E.
210 kva. 1520 rpm. 440/220 volt, Westinghouse
100 kva. 100 rpm. 440/220 volt. Westinghouse

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	230 (2)	G.E.	CD	1150
250	230 (2 new)	Cr. Wh.	CMC	1800
200	230	Cr. Wh.	CMC	890
150	230 (new)	Cr. Wh.	THPC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—300 kw, 1200 rpm, 250 v., G.E., connected to 500 hp, 1200 rpm, 2300/440 v., synchronous
1—165 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/220 v., squirrel cage
1—125 kw, 1200 rpm, 250/120 v., G.E., conn. to 175 hp, 1200 rpm, 4000/2300/440 v., synchronous
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 2300/440 v., synchronous
1—90 kw, 1200 rpm, 250 V., G.E., connected to 135 hp 2200/440 V. squirrel cage motor
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/440 v., syn. motor.

TRANSFORMERS 60 Cy.

3—400 kva, G. E., 13,800/6900—220/460 V.
3—225 kva, Whse., 4800/2400—240/480 V.
3—250 kva, G. E., 6900/13,800—230/460 V.
3—250 kva, Whse., 2400—240/480 V.
3—200 kva, G. E. 2400—240/480 V.
6—150 kva, Al. Chal., 2400—240/120 v.
1—150 kva, Whse. SK, 13200-125/215 v., 3 ph
3—100 kva, G. E., 4600/2300—460/220 V
3—100 kva, G.E., 13800—220/115 v., NEW
6—100 kva, G.E., 4600/2300-230/115., NEW
3—100 kva, G.E., 450-115/230 v., dry, 1 ph, new
2— 75 kva, G.E., 480—240/120 v., Pyranol
5— 75 kva, G.E., 2400-240/120 v.
3— 50 kva, G.E., 480—240/120 v. Pyranol

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HARRY J. RICE PRES.
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500 HP Boiler Plant Complete Built 1946

Two 250 HP 160# Wickes Type A Detroit Roto Stokers FD Fans and Thermix ID Stacks Coal Silo Elevator Hoppe Weigh Larry Deaerating Feed Water Heater.

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Centrifugal Brine Pump—5 H.P.—D.C. motor.
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Alloy Steel Impellers and Housings
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P.O. Box 765 Trenton, N. J.

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5—Ideal #6 Heating Sectional Boilers
3—125 HP Lucey Firebox Boilers, 200# WP gas burners, pumps, stacks, etc.
3—PennCo LP Boilers, jacketed with steel sheet, gas burners, controls. Type 6395A Serial F1323 9425 ft radiation.
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1—25,000# 1—15,000#
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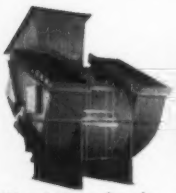

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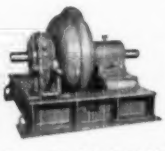

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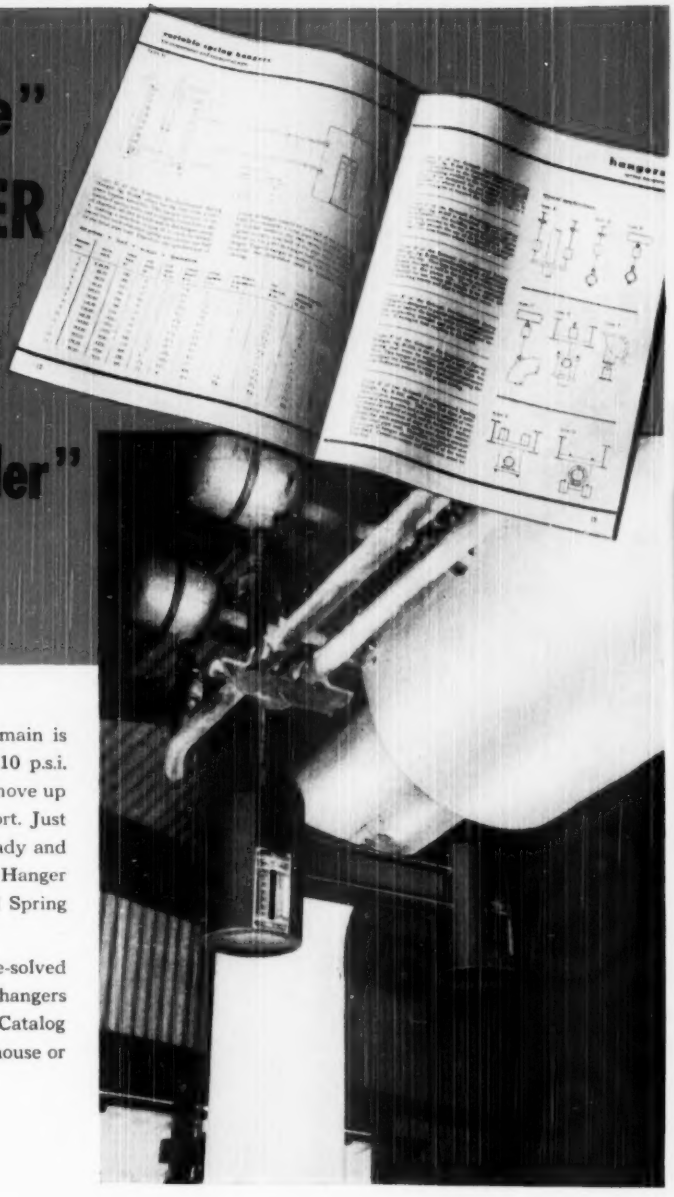

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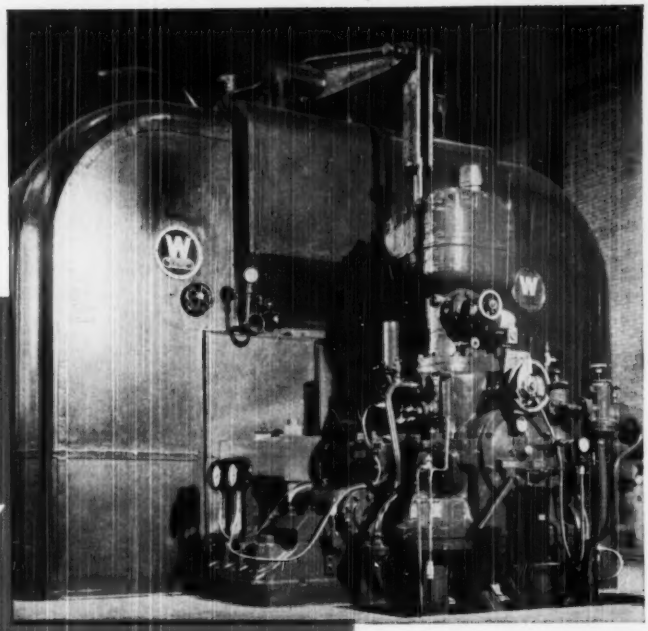

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